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GREY WATER DISPOSAL  
FROM  
PLEASURE BOATS

JANUARY 1991



Ontario

Environment  
Environnement



GREY WATER DISPOSAL FROM PLEASURE BOATS

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Report prepared for:  
Ontario Ministry of the Environment

January 1991



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PIBS 1422



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## 1.0 INTRODUCTION

### 1.1 General

Over 90,000 km<sup>2</sup> of waterways are accessible for recreational boating in Ontario, providing a large diversity of available boating landscapes ranging from high density urban areas, white sand beaches and secluded bays, to rugged, rocky bluffs, shores and islands. These waterways are heavily used during the peak boating season of July and August with up to 40,000 vessels present.

This large boating population is comprised of sailboats, power cruisers and house boats. The house boats generally frequent the quiet waters of the Trent and Rideau Canals and Lake of the Woods. Sailboats and power cruisers are found in these inland waters as well as in the open waters of the Great Lakes. The boats typically travel about the waterways during the daylight hours and seek out secluded anchorages and marinas for overnight accommodation.

Recreational boating has increased markedly in the last few years and is expected to continue to grow in popularity. With this increased boating pressure comes heightened concern from fisherman, cottagers and others, for the effects of this increased usage of the waterways. Specifically, concern has been expressed as to the effects of the direct discharge of grey water from recreational boats to the receiving waters.

Grey-water discharges are comprised of spent potable/fresh water used for "household" purposes, including water from galley sinks, head washbasins, and showers. On power cruisers and sailboats, grey water from the galley and head washbasin are typically discharged by gravity into the waterway through a submerged hull outlet. To dispose of grey waters from the shower sump, which is generally below the waterline, an electric or manual pump with an anti-siphon loop is typically provided, connecting into the drain pipe used for the washbasin. On houseboats, all grey waters typically discharge through drains to a point just above the waterline.

Concerns about the increased boating activity, and hence, increased grey-water discharges, relate not only to the perceived contamination of the waterways, but also to aesthetic effects including foaming, particularly in the softer water shield areas.

Sensitive areas are notably in restricted waterways and embayments such as those found in the Trent-Severn system, where boaters are in close proximity to cottagers and permanent residents. Inland waterways and bays may have minimal water exchange and high densities of boats, leading to more severe conditions than would be found in the open waters of the Great Lakes and larger inland lakes.

A previous study into the issue of grey water discharges from recreational vessels was commissioned by MOE (MacLaren Engineers, 1987). This study drew several conclusions from a literature review and cursory modelling study of the effects of grey water discharges. These included, among others:

1. "Available data on this subject indicate that bacterial pollution levels from grey water discharges can exceed the safe limit for recreational water uses (swimming, etc.) under certain high-season conditions. Chemical pollution levels are less significant."
2. "Recreational waterway sensitivity extends from lowest in the Great Lakes system to highest in a small quiet bay scenario involving maximum boating density in high-season."

The report also concluded that the grey water from recreational boats could be retained on-board but that such a measure would have the following implications:

- o increased boater costs for initial installation, and for subsequent pump-outs;
- o enforcement enhancement; and
- o modification of certain existing pump-out facilities to accommodate greater loadings, and construction of new pump-outs where required.

The MacLaren study recommended that a comprehensive sampling and analysis program be undertaken to identify the actual characteristics of the grey water from Ontario recreational boats and to determine the effect of the discharge of these waters upon the sheltered embayments which these vessels frequent.

The Ministry of the Environment commissioned the present study of the grey water discharges from recreational vessels with the following objectives:

- o determine the quantity of grey water, from each type of fixture, and quantity of blackwater produced aboard 3 types of boats - a sailboat, houseboat and power cruiser;
- o collect samples of grey water from each fixture type on each of the 3 boats to determine bacterial characteristics;
- o analyse receiving water at peak times of grey water discharge to determine bacterial characteristics;
- o evaluate the environmental significance of grey water discharges in areas of greatest recreational boating density;
- o survey the pump-out stations in 5 well-known areas to determine the capacity of the facilities to accept enhanced amounts of sewage.



## 2.0 STUDY DESIGN

This section describes in detail the work plan of the project according to the three main activities of on-board grey water sampling, instream sampling, and the survey of pumpout facilities.

### 2.1 On-board Sampling

The range of possible types of pleasure craft capable of generating grey water discharges is broad and includes any type of craft with any of the following fixtures: galley sink, head sink, and head shower. For the purposes of the present study three "generic" types of boats were considered each having a shower, a head sink, and a galley sink. These were a power cruiser, a sail boat, and a houseboat.

Quantification of the loading of grey water from each type of boat required an on-board sampling program to measure both the bacterial concentration in grey water and the corresponding volume of grey water produced. It is well established that bacterial concentration measurements can be highly variable, hence measurement programs must contain a sufficient number of samples to allow for statistically significant testing of results. Accordingly the sampling program established for this study was designed to provide an appropriate number of samples and associated quality control tests to allow for a rigorous evaluation of the results.

The on-board sampling program was designed to ensure that the samples collected were representative of the "boaters lifestyle". This required that the boats be operated by crews representative of the most probable types of boat operators and that conditions on board be maintained as closely as possible to typical conditions encountered on-board pleasure boats. The locations chosen for boat operation were limited by the requirement of being able to deliver the grey water samples to the laboratory for analysis not more than 24 hours following collection. Given the above constraints and the further constraint of finding available boats of the required type with the required grey water fixtures limited the geographical scope of the study area to Southern Georgian Bay and the Trent System between Port Severn and Peterborough.

To provide the required range of lifestyle on each type of boat three crews were used per boat for a total of 9 individual crews. The range of crew types included single couples, two couples, groups of 4 singles, couples with babies, and couples with young children. Through several discussions between Beak project staff and MOE personnel the following sampling schedule was developed:

| Boat type     | Duration<br>of Charter | Crew No. | Type of Crew                 | No. of "normal"<br>Samples Taken (1) |
|---------------|------------------------|----------|------------------------------|--------------------------------------|
| Houseboat     | 21 days                | 1        | 2 couples                    | 24                                   |
|               |                        | 2        | 1 couple with<br>1 child     | 24                                   |
|               |                        | 3        | 2 couples with<br>2 children | 24                                   |
| Power cruiser | 21 days                | 4        | 1 couple with<br>2 children  | 24                                   |
|               |                        | 5        | 4 singles                    | 24                                   |
|               |                        | 6        | 1 couple                     | 24                                   |
| Sailboat      | 18 days                | 7        | 2 couples                    | 24                                   |
|               |                        | 8        | 4 singles                    | 24                                   |
|               |                        | 9        | 2 couples                    | 24                                   |

1. "Normal" samples were collected from each of the shower, head sink, and galley sink twice daily, once in the morning and again in the evening.

Each of the sailboat crews were on-board for 5 consecutive days, each of the powerboat and houseboat crews were on-board for 6 consecutive days. For each type of boat and for each crew, samples were collected over consecutive 4 day periods. The overall sampling period spanned the interval from 27 July 1987 through to 14 August 1987. On



all boats the internal plumbing was modified to allow collection of the samples from the standard piping at a point prior to discharge.

Each of the samples was collected into a pre-sterilized Nalgene bottle with 5 litre capacity for the head and galley sinks and 10 litre capacity for the shower. With the exception of the volume of water used by some crew members during showering, these bottle sizes allowed virtually the complete contents of the various fixtures to be captured. A sub-sample for bacterial analysis was taken out of each Nalgene bottle into a pre-sterilized 100 ml glass bottle. All samples were stored on ice while on board the boats and during transportation to the laboratory. Samples were picked up from the boats and delivered to the laboratory on each day of sampling.

In addition to the samples taken as described above, two extra 100 ml sub-samples for on-board quality control checks were taken during one of the morning sampling periods of each crew on each boat for each fixture. To evaluate the effect of the galley sink piping special samples of the galley sink contents prior to release and from the boat piping as normally sampled were taken once by each of the first 2 crews on each boat.

This on-board sampling program generated 216 normal samples, 12 special samples, and 54 quality control samples for a total of 282 samples.

Grey water generation and overall fresh water use was monitored on board each boat by recording the volume of fresh water used at the time of each fresh water tank filling. This was accomplished using a calibrated positive displacement totalizing water meter similar to those used to meter domestic water use. Black (toilet waste) water generation was estimated by measuring the capacity of the waste holding tank in each boat and recording the frequency of pumpouts. As a check on this system for black water estimation a system of pumping the black water into a graduated 55 litre carboy was used.

## **2.2 In-stream Sampling**

The objective of the in-stream sampling program was to determine the local effects of greywater discharges from pleasure boats by monitoring bacterial water quality and boat density in sheltered embayments with limited water exchange and minimal external influences.

To achieve this objective three sheltered embayments were selected: two on southern Georgian Bay (Figure 2.1), and one on the central Trent Canal (Figure 2.2). These general locations were chosen because of the large number of recreational boaters frequenting the bays and coastal areas, the large number of sheltered embayments, and the historical concerns over deteriorating water quality particularly in the Trent Canal system. From a logistical perspective these areas were also ideal as samples could be picked up and delivered to the Toronto laboratory for analysis within 24 hours of collection.

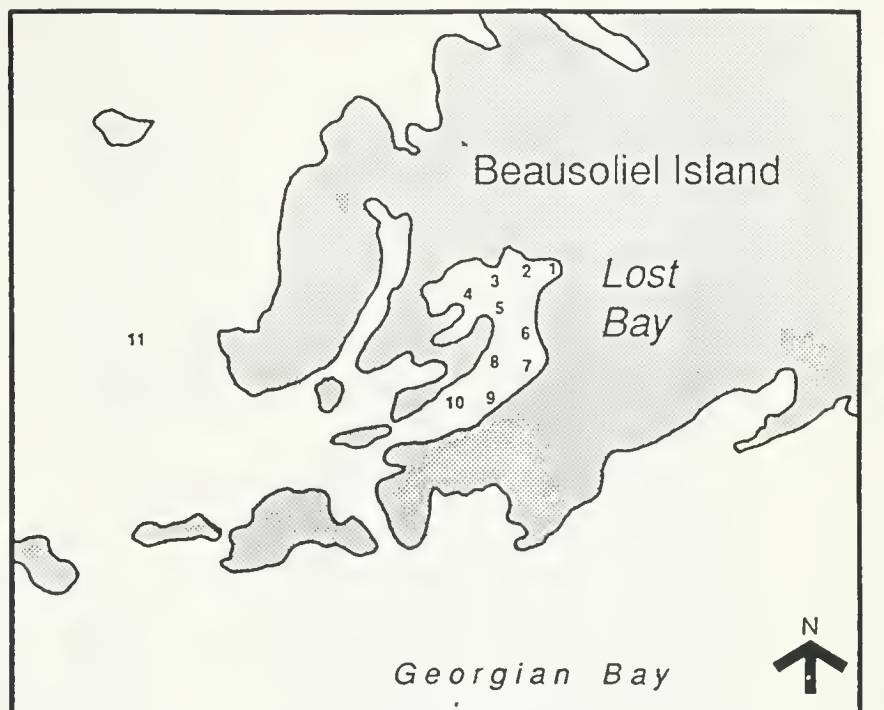
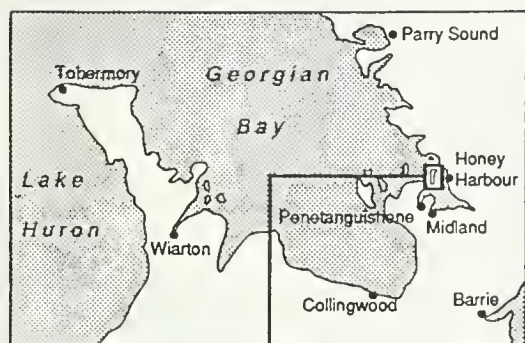
Theoretically, the objectives of this component of the study could best be met if the selected embayments were small in volume, completely free of bacterial inputs other than from recreational boating, and had limited exchange flow with the surrounding water. This combination of physical factors together with a high density of boats would maximize the probability of detecting a deterioration in bacterial water quality due to recreational boating. However, practical considerations limited our selection of candidate embayments. Most of the study area has extensive shore line development with its associated bacterial sources, and open channels allowing both safe boat traffic and large volume exchange with surrounding waters.

Following several discussions on likely candidate sites with MOE regional staff, Parks Canada personnel, and MNR regional staff, the following three areas were selected for study:

|                |   |
|----------------|---|
| Lost Bay       | Georgian Bay Islands National Park<br>Beausoliel Island |
| Frying Pan Bay | Georgian Bay Islands National Park<br>Beausoliel Island |
| Blind Channel  | Trent-Severn Waterway<br>Pigeon Lake                    |

Samples were collected from 10 pre-selected locations within each bay and at one control point outside of each bay. Collections were made morning and evening on three consecutive days over two weekends during the summer of 1987 (August 1,2,3; August



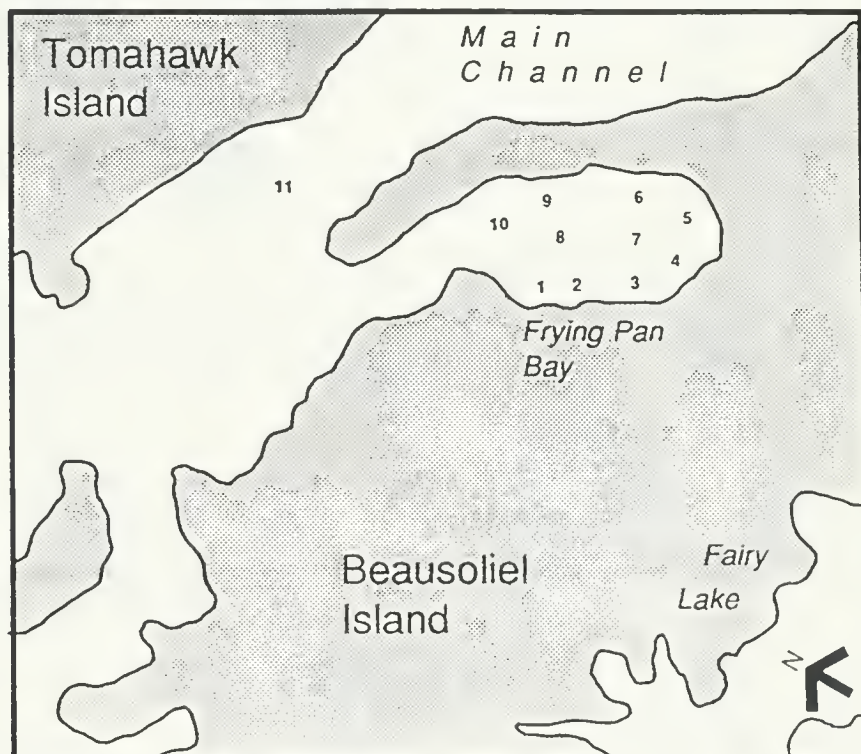
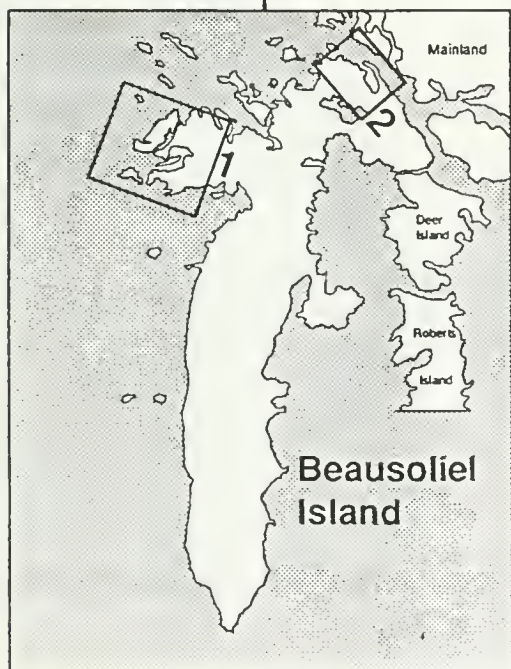


- 1** Sampling Sites  
1-10 Embayment  
11 Background

0 200 400 600 800 m

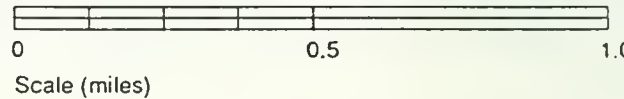
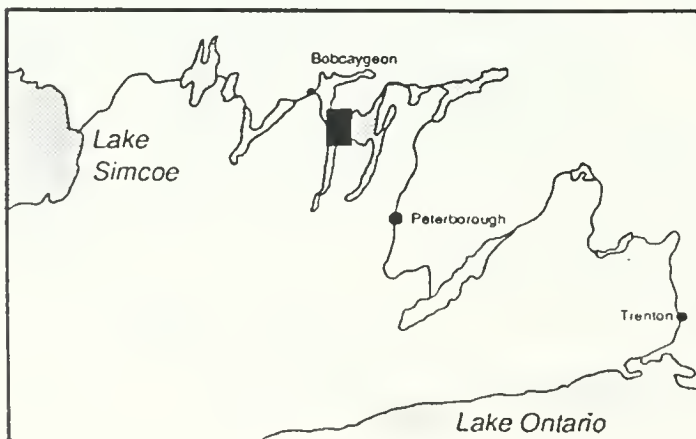
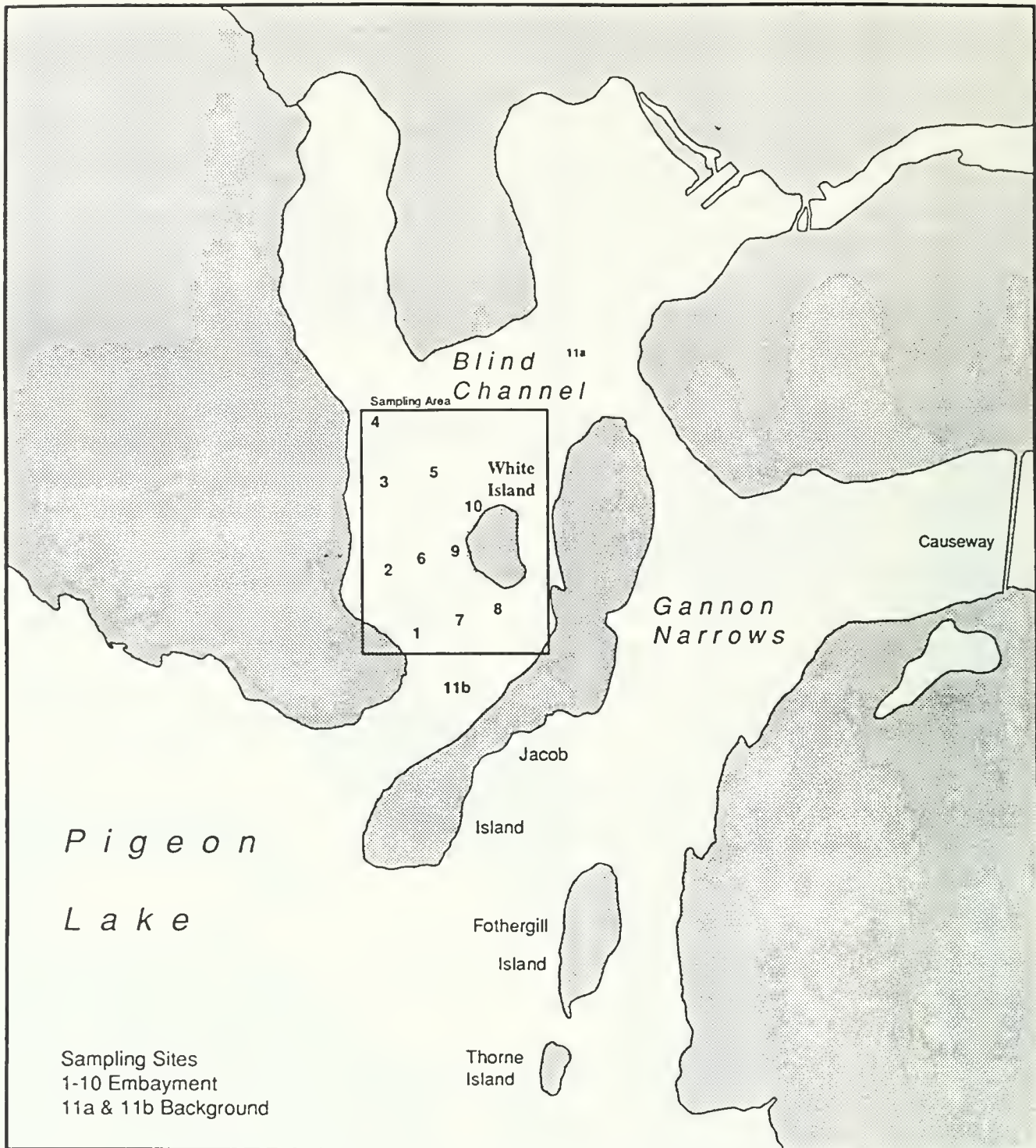
**2**

0 200 400 m



**FIGURE 2.1**  
Southern Georgian Bay  
Sampling Locations





**FIGURE 2.2**  
Instream Sampling  
Location-  
Blind Channel,  
Trent Canal System

8,9,10) for a total of 396 regular samples. An additional two quality control samples were collected from each sampling site in each bay in the morning on August 2 and again on August 9 for an additional 132 samples. During each sampling period the number and type of boats in each of the embayments were noted according to the following classifications:

| <u>Type</u>     | <u>Presumed Grey Water Fixtures</u> |
|-----------------|-------------------------------------|
| Sailboat A      | Head and galley sinks, shower       |
| Sailboat B      | Head and galley sinks               |
| Houseboat       | Head and galley sinks, shower       |
| Power cruiser A | Head and galley sinks, shower       |
| Power cruiser B | Head and galley sinks               |
| Runabout        | Galley sink                         |

During each day of sampling drift drogues with vane depths of 1 metre were placed in the entrance channels of each embayment to qualitatively assess exchange flow. The progress of the drogues into or out of the embayments and the elapsed time of movement were noted. Water temperature and general weather conditions were also noted.

### 2.3 Bacteriological and Chemical Characterizations

All samples were stored on ice after collection and were transported to Toronto for analysis within 8 to 24 hours. The schedule of analysis and laboratory procedures were specified by MOE in the Study Terms of Reference. The salient points are reproduced below.

Each sample was analysed for fecal coliforms, E. coli, and Pseudomonas aeruginosa. In addition, the first three on-board grey water samples from each fixture on each boat were analysed for the following parameters:

Fecal streptococci,  
Total phosphorus (as P),  
Soluble phosphorus (as P),  
Total solids,

Suspended solids,  
 BOD<sub>5</sub>,  
 Total organic carbon,  
 Chemical oxygen demand,  
 Ammonia (as N), and  
 Total kjeldahl nitrogen (as N).

Laboratory procedures for the analysis of fecal coliforms, Pseudomonas aeruginosa and fecal streptococci were in accordance with the procedures specified in MOE's "Handbook of Analytical Methods for Environmental Samples" ("HAMES"). Laboratory procedures for E. coli followed the procedure outlined in the Study Terms of Reference. Verification of E. coli by isolation and identification of presumptive target colonies was completed on the first 6 on-board grey water samples per boat per fixture.

In addition to the samples collected for analysis which included in-field quality control samples as described in sections 2.2 and 2.3 above, in-lab quality control replicate bacteriological analyses were performed on a minimum 5 percent of the samples.

#### 2.4 Marina Pumpout Capacity Survey

A survey of excess pumpout capacity was undertaken to assess the reserve capacity available within the existing pumpout network should MOE elect to regulate the disposal of grey water in the same manner as black water. There are approximately 380 pumpout facilities within the province. For the purposes of the present study, five areas were selected for the survey. These were as follows:

| <u>Region</u>  | <u>Number of Pumpout<br/>Facilities</u> |
|--|---|
| 1 Trent System - Peterborough to Rosedale                      | 32                                      |
| 2 Kingston area and Rideau System<br>- Kingston to Smith Falls | 23                                      |
| 3 Georgian Bay - Penetanguishene to Honey Harbour              | 22                                      |
| 4 Toronto area - Bronte to Oshawa                              | 27                                      |
| 5 Lake of the Woods - Morbon to Keewatin                       | <u>14</u>                               |
|  | 118                                     |

With the exception of the Lake of the Woods area which was surveyed by telephone, each of the other areas was surveyed by site visits. Those facilities in areas 1 through 4 which could not be located, or where personal interviews were not possible were followed up by telephone contact. In all cases a questionnaire identical in form to the sample presented in Figure 2.3 was completed. The data compiled from the questionnaires were analysed for residual capacity and difficulties which might be encountered with increased demand.



SAMPLE QUESTIONNAIRE  
SURVEY OF PUMPOUT STATIONS

Site Visit: \_\_\_\_\_

Telephone: \_\_\_\_\_

Name: \_\_\_\_\_

Location: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ Telephone: \_\_\_\_\_

Contact: \_\_\_\_\_

Pumpout Capacity: \_\_\_\_\_

(Volume + # Tanks)

Number of boats serviced at a time: \_\_\_\_\_

Any access problems: \_\_\_\_\_

Disposal method from holding tanks: \_\_\_\_\_

(haul by truck, septic tank, leach bed)

Anticipated problems in providing more frequent removal/disposal from holding tanks:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Other comments/remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

FIGURE 2.3

## 3.0 RESULTS AND DISCUSSION

### 3.1 Grey Water Sampling

#### 3.1.1 General

The sampling onboard the three boats was carried out by intercepting the flow from the head sink, the galley sink and the shower prior to discharge overboard. Samples were collected twice daily, in the morning and evening and were shipped to the laboratory for analysis within 24 hours. All samples were analysed for fecal coliform, E. coli and Pseudomonas aeruginosa. A limited number of samples collected early in the sampling program were also analysed for fecal streptococcus. Approximately 22% of the samples were duplicated to provide a quality assurance data set. The results of the analyses are presented in Appendix A and summarized in Tables 3.1 (by boat) and 3.2 (by fixture).

#### 3.1.2 Grey Water Data Analysis

The analysis of the data from the boats was intended to determine differences in the characteristics of the grey water based upon different crews, different fixture types and different boat types. To accomplish this, the data were first reviewed visually in tabular and graphical form where appropriate and then subjected to various Analysis of Variance statistical tests.

The geometric mean of the fecal coliform densities varied from  $10^4$  to  $10^8$  organisms per 100 ml over the entire data set. The galley sink water appeared to have the highest density of the three fixtures with values in the  $10^7$  organisms per 100 ml range. Densities in the head sink were found to be in the  $10^5$  to  $10^7$  organisms per 100 ml range and the shower waters ranged from  $10^4$  to  $10^7$  organisms per 100 ml. These values exhibit good agreement with the values reported by MacLaren (1986) in their review of the literature. In fact, the values reported by MacLaren for black water are occasionally less than the grey water values found here.

The variation in densities between fixtures and between boats is not distinct. Box plots of the results indicate some overlap in the measured ranges due to the large variances and that any differences between the fixtures, crews or boats may be incidental (Figures 3.1 to 3.2).

TABLE 3.1:  
SUMMARY OF BACTERIOLOGICAL RESULTS OF ON BOARD SAMPLING, BY BOAT, CREW, AND FIXTURE<sup>1</sup>

| FECAL COLIFORMS |           |  |                |                    | E. COLI                                |                |                    | PSEUDOMONAS AERUGINOSA                 |                |                    |  |
|-----------------|-----------|--|----------------|--------------------|--|----------------|--------------------|--|----------------|--------------------|--|
| Crew            | Fixture   | Geo Mean<br>Concentration<br>(/100 ml) | Mean<br>of Log | Variance<br>of Log | Geo. Mean<br>Concentration<br>(/100ml) | Mean<br>of Log | Variance<br>of Log | Geo. Mean<br>Concentration<br>(/100ml) | Mean<br>of Log | Variance<br>of Log |  |
| HOUSEBOAT       |           |  |                |                    |  |                |                    |  |                |                    |  |
| 1               | GALLEY    | 1.40 x 10 <sup>7</sup>                 | 7.146          | 0.662              | 1.07 x 10 <sup>7</sup>                 | 7.028          | 0.918              | 9.42 x 10 <sup>2</sup>                 | 2.974          | 0.590              |  |
| 2               | GALLEY    | 6.54 x 10 <sup>8</sup>                 | 8.816          | 0.148              | 2.68 x 10 <sup>8</sup>                 | 8.428          | 0.152              | 1.71 x 10 <sup>4</sup>                 | 4.234          | 2.835              |  |
| 3               | GALLEY    | 1.94 x 10 <sup>6</sup>                 | 8.288          | 0.292              | 6.14 x 10 <sup>6</sup>                 | 7.789          | 0.406              | 1.00 x 10 <sup>4</sup>                 | 4.000          | 0.286              |  |
| 1               | HEAD      | 2.99 x 10 <sup>7</sup>                 | 6.476          | 1.787              | 2.24 x 10 <sup>6</sup>                 | 6.349          | 1.637              | 1.09 x 10 <sup>3</sup>                 | 3.037          | 0.780              |  |
| 2               | HEAD      | 1.34 x 10 <sup>7</sup>                 | 7.128          | 0.052              | 3.22 x 10 <sup>6</sup>                 | 6.508          | 0.274              | 1.43 x 10 <sup>4</sup>                 | 4.156          | 0.153              |  |
| 3               | HEAD      | 9.88 x 10 <sup>6</sup>                 | 6.995          | 0.064              | 2.57 x 10 <sup>6</sup>                 | 6.409          | 0.237              | 3.07 x 10 <sup>4</sup>                 | 4.488          | 0.198              |  |
| 1               | SHOWER    | 1.23 x 10 <sup>6</sup>                 | 6.088          | 1.279              | 4.56 x 10 <sup>5</sup>                 | 5.659          | 1.431              | 1.86 x 10 <sup>2</sup>                 | 2.269          | 0.437              |  |
| 2               | SHOWER    | 1.49 x 10 <sup>7</sup>                 | 7.173          | 0.272              | 5.37 x 10 <sup>6</sup>                 | 6.730          | 0.463              | 4.58 x 10 <sup>3</sup>                 | 3.660          | 0.922              |  |
| 3               | SHOWER(2) | 4.69 x 10 <sup>5</sup>                 | 5.671          | 0.001              | 4.53 x 10 <sup>5</sup>                 | 5.656          | 0.002              | 3.00 x 10 <sup>4</sup>                 | 4.476          | 1.856              |  |
| POWERBOAT       |           |  |                |                    |  |                |                    |  |                |                    |  |
| 4               | GALLEY    | 6.19 x 10 <sup>7</sup>                 | 7.792          | 0.756              | 5.30 x 10 <sup>7</sup>                 | 7.724          | 0.654              | 3.51 x 10 <sup>5</sup>                 | 5.545          | 2.198              |  |
| 5               | GALLEY    | 1.16 x 10 <sup>7</sup>                 | 7.064          | 0.185              | 9.35 x 10 <sup>6</sup>                 | 6.971          | 0.159              | 2.20 x 10 <sup>5</sup>                 | 5.343          | 2.820              |  |
| 6               | GALLEY    | 1.92 x 10 <sup>7</sup>                 | 7.282          | 2.313              | 1.49 x 10 <sup>7</sup>                 | 7.174          | 2.168              | 1.68 x 10 <sup>6</sup>                 | 6.226          | 0.684              |  |
| 4               | HEAD      | 4.89 x 10 <sup>5</sup>                 | 5.690          | 0.471              | 3.77 x 10 <sup>5</sup>                 | 5.577          | 0.396              | 4.36 x 10 <sup>4</sup>                 | 4.639          | 0.572              |  |
| 5               | HEAD      | 3.44 x 10 <sup>5</sup>                 | 5.537          | 0.661              | 2.42 x 10 <sup>5</sup>                 | 5.383          | 0.780              | 1.37 x 10 <sup>4</sup>                 | 4.137          | 0.656              |  |
| 6               | HEAD      | 1.32 x 10 <sup>5</sup>                 | 5.121          | 0.733              | 1.24 x 10 <sup>5</sup>                 | 5.095          | 0.739              | 8.55 x 10 <sup>4</sup>                 | 4.932          | 1.051              |  |
| 4               | SHOWER    | 2.48 x 10 <sup>6</sup>                 | 6.394          | 0.557              | 2.14 x 10 <sup>6</sup>                 | 6.331          | 0.411              | 2.43 x 10 <sup>6</sup>                 | 6.385          | 0.345              |  |
| 5               | SHOWER    | 1.69 x 10 <sup>6</sup>                 | 6.228          | 0.584              | 1.63 x 10 <sup>6</sup>                 | 6.213          | 0.585              | 6.00 x 10 <sup>4</sup>                 | 4.778          | 0.633              |  |
| 6               | SHOWER    | 1.90 x 10 <sup>6</sup>                 | 6.279          | 1.203              | 1.64 x 10 <sup>6</sup>                 | 6.215          | 1.132              | 6.67 x 10 <sup>5</sup>                 | 5.824          | 2.100              |  |
| SAILBOAT        |           |  |                |                    |  |                |                    |  |                |                    |  |
| 7               | GALLEY    | 6.28 x 10 <sup>4</sup>                 | 4.798          | 7.213              | 4.56 x 10 <sup>4</sup>                 | 4.659          | 7.192              | 1.51 x 10 <sup>4</sup>                 | 4.180          | 1.053              |  |
| 8               | GALLEY    | 2.16 x 10 <sup>7</sup>                 | 7.335          | 1.369              | 1.20 x 10 <sup>7</sup>                 | 7.079          | 1.700              | 9.13 x 10 <sup>3</sup>                 | 3.961          | 1.825              |  |
| 9               | GALLEY    | 6.20 x 10 <sup>7</sup>                 | 7.792          | 0.144              | 5.96 x 10 <sup>7</sup>                 | 7.776          | 0.153              | 1.13 x 10 <sup>4</sup>                 | 4.052          | 0.157              |  |
| 7               | HEAD      | 1.44 x 10 <sup>5</sup>                 | 5.159          | 1.012              | 7.91 x 10 <sup>4</sup>                 | 4.898          | 1.442              | 1.85 x 10 <sup>3</sup>                 | 3.267          | 0.643              |  |
| 8               | HEAD      | 2.10 x 10 <sup>6</sup>                 | 6.323          | 0.629              | 1.19 x 10 <sup>6</sup>                 | 6.075          | 0.519              | 4.50 x 10 <sup>5</sup>                 | 5.653          | 0.520              |  |
| 9               | HEAD      | 7.86 x 10 <sup>4</sup>                 | 6.896          | 0.155              | 3.38 x 10 <sup>6</sup>                 | 6.529          | 0.463              | 2.59 x 10 <sup>6</sup>                 | 6.413          | 0.304              |  |
| 7               | SHOWER    | 9.74 x 10 <sup>4</sup>                 | 4.988          | 0.723              | 4.56 x 10 <sup>4</sup>                 | 4.659          | 0.828              | 6.18 x 10 <sup>3</sup>                 | 3.791          | 1.158              |  |
| 8               | SHOWER    | 1.60 x 10 <sup>6</sup>                 | 6.205          | 0.212              | 1.11 x 10 <sup>6</sup>                 | 6.045          | 0.235              | 2.65 x 10 <sup>4</sup>                 | 4.423          | 0.717              |  |
| 9               | SHOWER    | 3.35 x 10 <sup>6</sup>                 | 6.526          | 0.141              | 3.24 x 10 <sup>6</sup>                 | 6.510          | 0.150              | 7.00 x 10 <sup>4</sup>                 | 4.845          | 0.579              |  |

Note: 1 each crew typically collected 8 samples from each fixture  
2 only 2 samples were collected

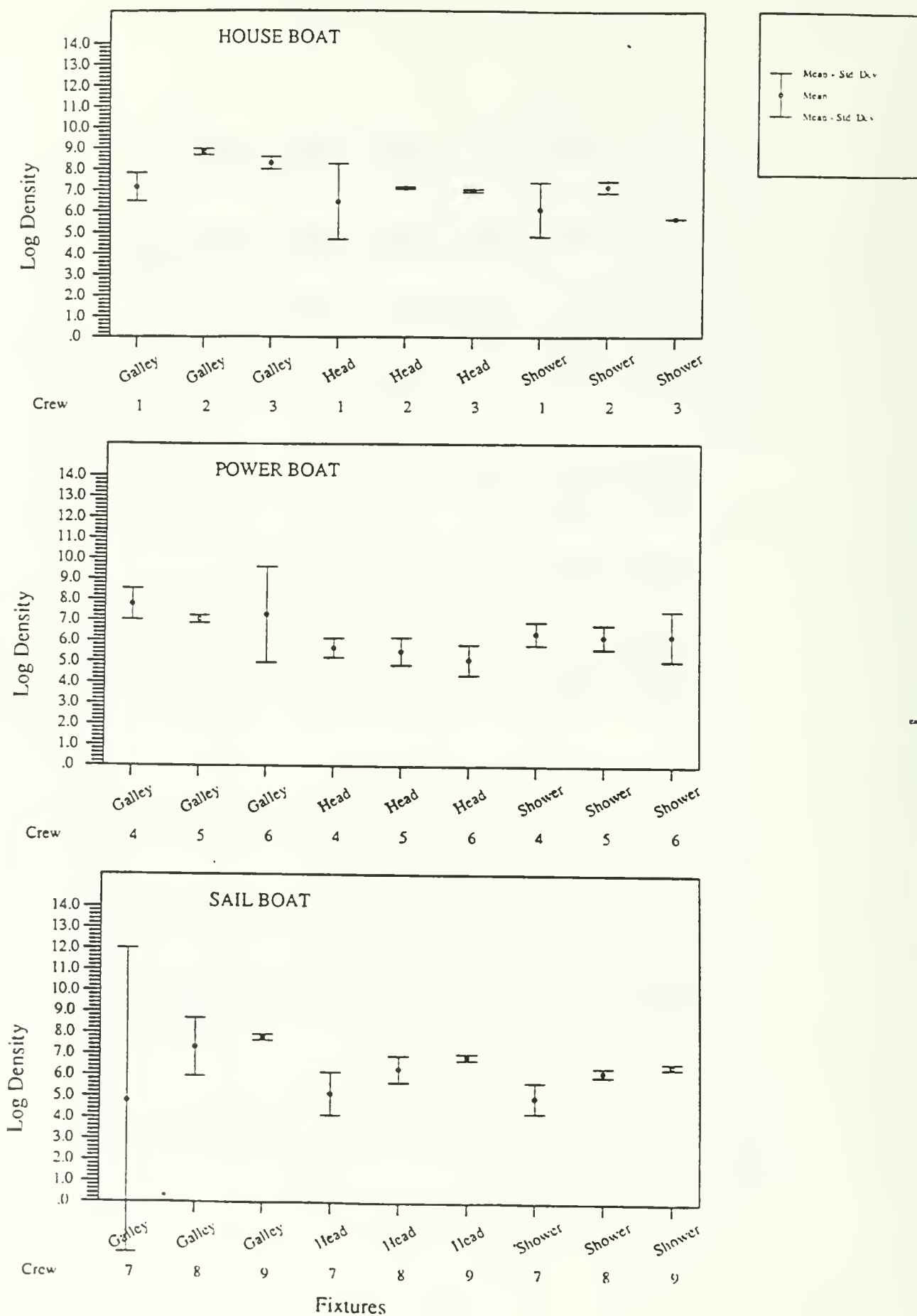


TABLE 3.2: SUMMARY OF BACTERIOLOGICAL RESULTS OF ON BOARD SAMPLING, BY FIXTURE, CREW, AND BOAT<sup>1</sup>

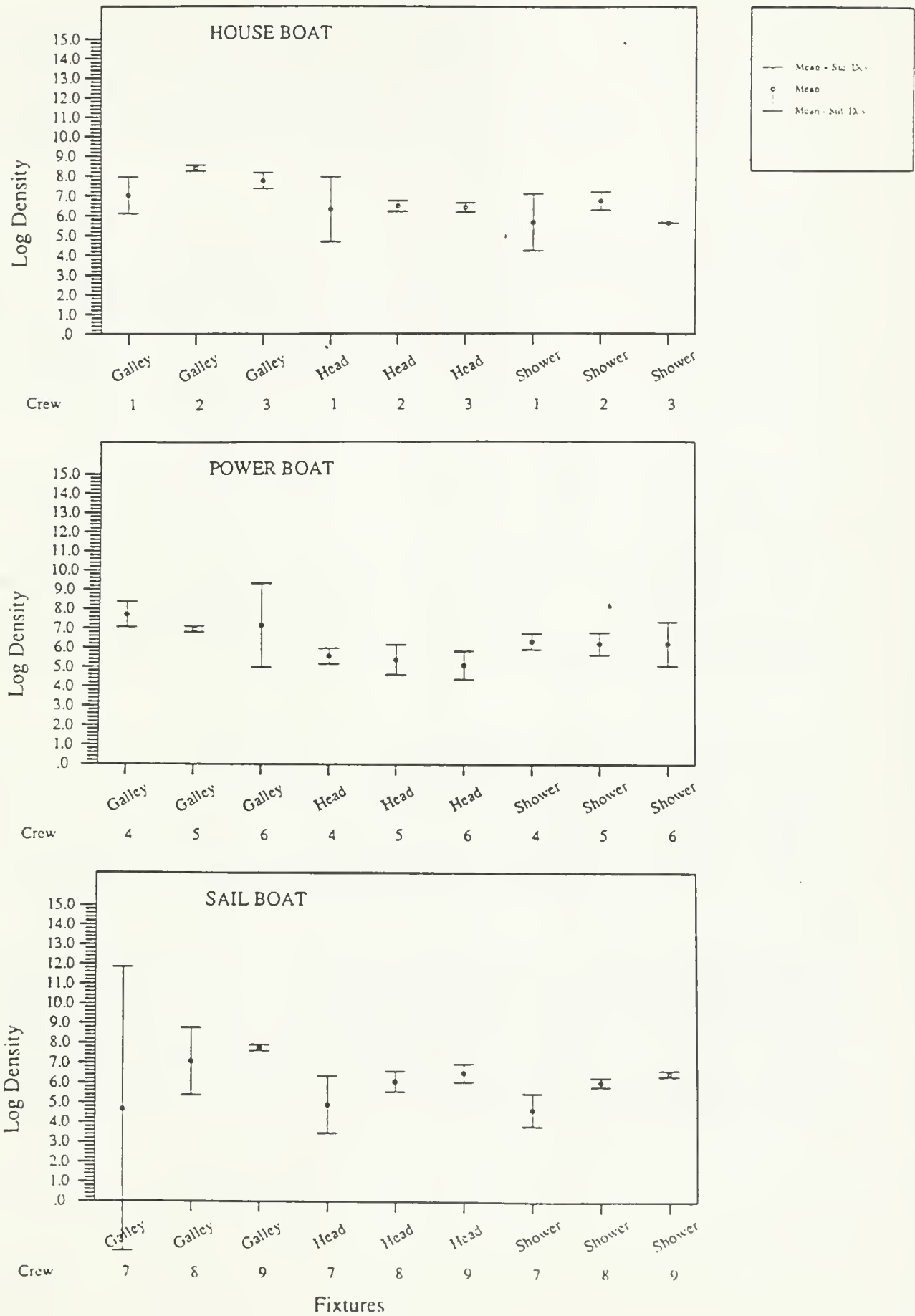
| Crew        | Boat     | FECAL COLIFORMS                        |                |                    | E. COLI                                |                |                    | PSUDOMONAS AERUGINOSA                  |                |                    |
|-------------|----------|--|----------------|--------------------|--|----------------|--------------------|--|----------------|--------------------|
|             |          | Geo. Mean<br>Concentration<br>(/100ml) | Mean<br>of Log | Variance<br>of Log | Geo. Mean<br>Concentration<br>(/100ml) | Mean<br>of Log | Variance<br>of Log | Geo. Mean<br>Concentration<br>(/100ml) | Mean<br>of Log | Variance<br>of Log |
| GALLEY SINK |          |  |                |                    |  |                |                    |  |                |                    |
| 1           | HOUSE    | 1.40 × 10 <sup>7</sup>                 | 7.146          | 0.662              | 1.07 × 10 <sup>7</sup>                 | 7.028          | 0.918              | 9.42 × 10 <sup>2</sup>                 | 2.974          | 0.590              |
| 2           | HOUSE    | 6.54 × 10 <sup>8</sup>                 | 8.816          | 0.148              | 2.68 × 10 <sup>8</sup>                 | 8.428          | 0.152              | 1.71 × 10 <sup>4</sup>                 | 4.234          | 2.835              |
| 3           | HOUSE    | 1.94 × 10 <sup>8</sup>                 | 8.287          | 0.292              | 6.14 × 10 <sup>7</sup>                 | 7.789          | 0.406              | 1.00 × 10 <sup>4</sup>                 | 4.000          | 0.286              |
| 4           | POWER    | 6.19 × 10 <sup>7</sup>                 | 7.792          | 0.756              | 5.30 × 10 <sup>7</sup>                 | 7.724          | 0.654              | 3.51 × 10 <sup>5</sup>                 | 5.545          | 2.198              |
| 5           | POWER    | 1.16 × 10 <sup>7</sup>                 | 7.064          | 0.185              | 9.35 × 10 <sup>6</sup>                 | 6.970          | 0.159              | 2.20 × 10 <sup>5</sup>                 | 5.343          | 2.820              |
| 6           | POWER    | 1.92 × 10 <sup>7</sup>                 | 7.282          | 2.313              | 1.49 × 10 <sup>7</sup>                 | 7.173          | 2.168              | 1.68 × 10 <sup>6</sup>                 | 6.226          | 0.684              |
| 7           | SAIL     | 6.28 × 10 <sup>4</sup>                 | 4.798          | 7.213              | 4.56 × 10 <sup>4</sup>                 | 4.660          | 7.192              | 1.51 × 10 <sup>4</sup>                 | 4.180          | 1.053              |
| 8           | SAIL     | 2.16 × 10 <sup>7</sup>                 | 7.335          | 1.369              | 1.20 × 10 <sup>7</sup>                 | 7.079          | 1.700              | 9.13 × 10 <sup>3</sup>                 | 3.961          | 1.825              |
| 9           | SAIL     | 6.20 × 10 <sup>7</sup>                 | 7.792          | 0.144              | 5.96 × 10 <sup>7</sup>                 | 7.776          | 0.153              | 1.13 × 10 <sup>4</sup>                 | 4.052          | 0.157              |
| HEAD SINK   |          |  |                |                    |  |                |                    |  |                |                    |
| 1           | HOUSE    | 2.99 × 10 <sup>6</sup>                 | 6.476          | 1.787              | 2.24 × 10 <sup>6</sup>                 | 6.349          | 1.637              | 1.09 × 10 <sup>3</sup>                 | 3.037          | 0.780              |
| 2           | HOUSE    | 1.34 × 10 <sup>7</sup>                 | 7.128          | 0.052              | 3.22 × 10 <sup>6</sup>                 | 6.508          | 0.274              | 1.43 × 10 <sup>4</sup>                 | 4.156          | 0.153              |
| 3           | HOUSE    | 9.88 × 10 <sup>6</sup>                 | 6.995          | 0.064              | 2.57 × 10 <sup>6</sup>                 | 6.409          | 0.237              | 3.07 × 10 <sup>4</sup>                 | 4.488          | 0.190              |
| 4           | POWER    | 4.89 × 10 <sup>5</sup>                 | 5.690          | 0.471              | 3.77 × 10 <sup>5</sup>                 | 5.577          | 0.396              | 4.36 × 10 <sup>4</sup>                 | 4.639          | 0.572              |
| 5           | POWER    | 3.44 × 10 <sup>5</sup>                 | 5.537          | 0.661              | 2.42 × 10 <sup>5</sup>                 | 5.383          | 0.780              | 1.37 × 10 <sup>4</sup>                 | 4.137          | 0.656              |
| 6           | POWER    | 1.32 × 10 <sup>5</sup>                 | 5.121          | 0.733              | 1.24 × 10 <sup>5</sup>                 | 5.095          | 0.739              | 8.55 × 10 <sup>4</sup>                 | 4.932          | 1.051              |
| 7           | SAIL     | 1.44 × 10 <sup>5</sup>                 | 5.159          | 1.012              | 7.91 × 10 <sup>4</sup>                 | 4.898          | 1.442              | 1.85 × 10 <sup>3</sup>                 | 3.267          | 0.643              |
| 8           | SAIL     | 2.10 × 10 <sup>6</sup>                 | 6.323          | 0.629              | 1.19 × 10 <sup>6</sup>                 | 6.075          | 0.519              | 4.50 × 10 <sup>5</sup>                 | 5.653          | 0.520              |
| 9           | SAIL     | 7.86 × 10 <sup>6</sup>                 | 6.896          | 0.155              | 3.38 × 10 <sup>6</sup>                 | 6.529          | 0.463              | 2.59 × 10 <sup>6</sup>                 | 6.413          | 0.304              |
| SHOWER      |          |  |                |                    |  |                |                    |  |                |                    |
| 1           | HOUSE    | 1.23 × 10 <sup>6</sup>                 | 6.088          | 1.279              | 4.56 × 10 <sup>5</sup>                 | 5.659          | 1.431              | 1.86 × 10 <sup>2</sup>                 | 2.269          | 0.437              |
| 2           | HOUSE    | 1.49 × 10 <sup>7</sup>                 | 7.173          | 0.272              | 5.37 × 10 <sup>6</sup>                 | 6.730          | 0.463              | 4.58 × 10 <sup>3</sup>                 | 3.660          | 0.922              |
| 3           | HOUSE(2) | 4.69 × 10 <sup>5</sup>                 | 5.671          | 0.001              | 4.53 × 10 <sup>5</sup>                 | 5.656          | 0.002              | 3.00 × 10 <sup>4</sup>                 | 4.476          | 1.856              |
| 4           | POWER    | 2.48 × 10 <sup>6</sup>                 | 6.394          | 0.557              | 2.14 × 10 <sup>6</sup>                 | 6.331          | 0.411              | 2.43 × 10 <sup>6</sup>                 | 6.385          | 0.345              |
| 5           | POWER    | 1.69 × 10 <sup>6</sup>                 | 6.228          | 0.584              | 1.63 × 10 <sup>6</sup>                 | 6.213          | 0.585              | 6.00 × 10 <sup>4</sup>                 | 4.778          | 0.633              |
| 6           | POWER    | 1.90 × 10 <sup>6</sup>                 | 6.279          | 1.203              | 1.64 × 10 <sup>6</sup>                 | 6.215          | 1.132              | 6.67 × 10 <sup>5</sup>                 | 5.824          | 2.100              |
| 7           | SAIL     | 9.74 × 10 <sup>4</sup>                 | 4.988          | 0.723              | 4.56 × 10 <sup>4</sup>                 | 4.659          | 0.828              | 6.18 × 10 <sup>3</sup>                 | 3.791          | 1.158              |
| 8           | SAIL     | 1.60 × 10 <sup>6</sup>                 | 6.205          | 0.212              | 1.11 × 10 <sup>6</sup>                 | 6.045          | 0.235              | 2.65 × 10 <sup>4</sup>                 | 4.423          | 0.717              |
| 9           | SAIL     | 3.35 × 10 <sup>6</sup>                 | 6.526          | 0.141              | 3.24 × 10 <sup>6</sup>                 | 6.510          | 0.150              | 7.00 × 10 <sup>4</sup>                 | 4.845          | 0.579              |

Note: 1 each crew typically called 8 samples from each fixture  
2 only 2 samples were collected

**FIGURE 3.1**  
**FECAL COLIFORM RESULTS**



**FIGURE 3.2**  
**ESCHERICHIA COLI RESULTS**



As expected, the reported E. coli densities were slightly less than the fecal coliform densities. The E. coli data exhibited the same general trend as the fecal coliforms data with the galley sink water having the highest apparent density and the shower water being the lowest (Figure 3.2). As in the case of the fecal coliforms data, the differences between the various fixtures and boats was not distinct.

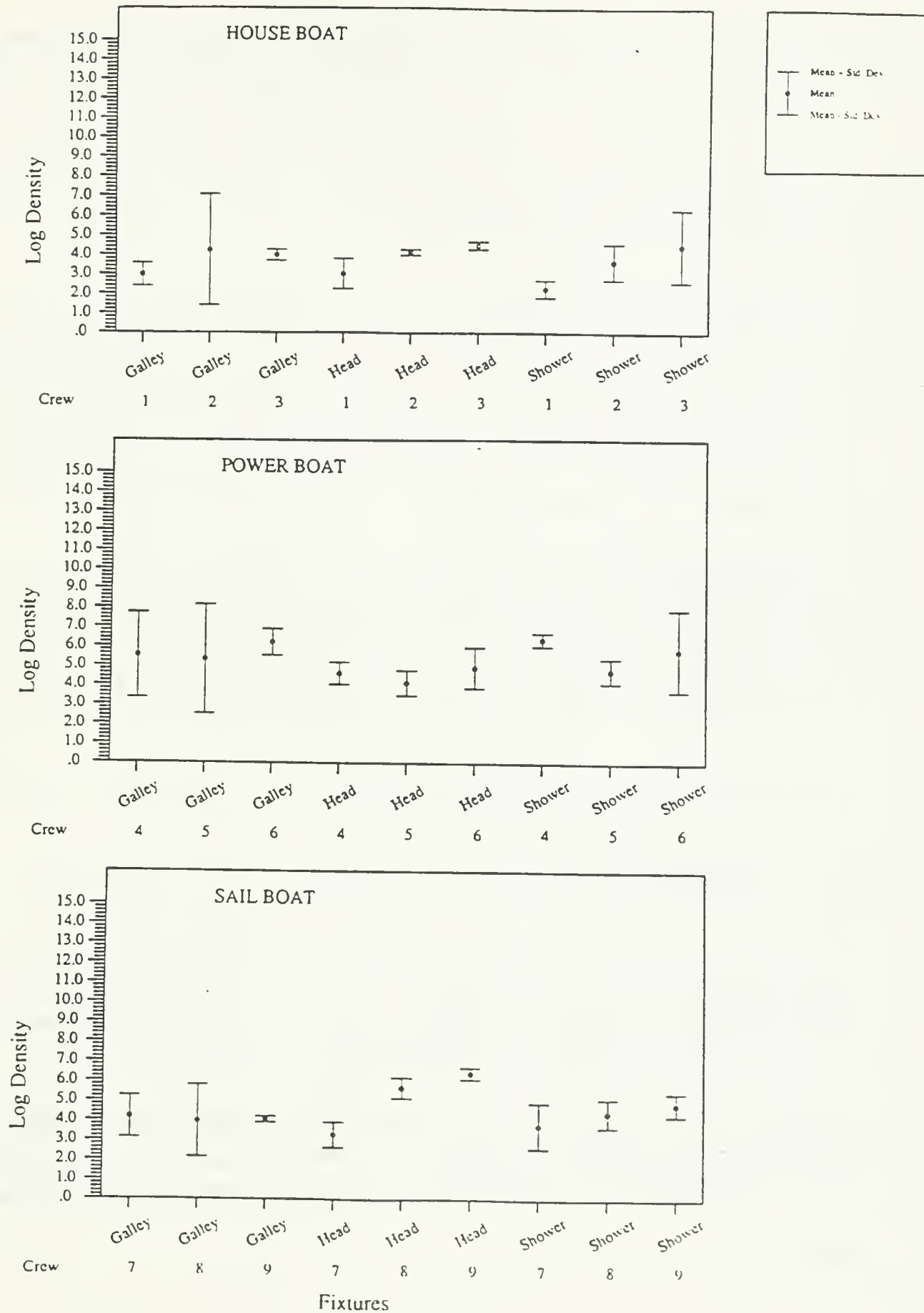
Pseudomonas aeruginosa (P. aeruginosa) is an opportunistic pathogen which is known to cause eye and ear infections in swimmers. The densities measured in the grey waters ( $10^3$  to  $10^6$  organisms per 100 ml) represent high values when compared to normally occurring environmental densities which are typically less than 50 organisms per 100 ml. Visual inspection of the P. aeruginosa results did not suggest any relationship among the various factors identified above for the other two species (Figure 3.3).

The onboard sampling program was designed to determine the effects of three factors on grey water quality: type of boat (house, power, sail), crew lifestyle, fixture type (shower, head sink, galley sink). As discussed above, crews were chosen to represent a variety of lifestyles from families with young children to groups of adults. However, unlike the differences in boats and fixtures which are physically distinct, crew types are less easily defined due to the continuum of lifestyles. The variability in greywater quality due to crew type may mask the effects of boat type and fixture type.

To account for the effects of all the variables in the design of the study, the grey water quality data were subjected to a sequence of nested ANOVA analyses in which the variability of the data was partitioned amongst the design variables (boats, crews and fixtures). In all cases the data were log transformed and the effects of the design variables were tested for statistical significance at the 95 percent confidence level.

This procedure is designed to determine which, if any, of the above three factors contributed significantly to the variability of the data set. By implication significant factors might be considered for regulatory action if the discharge to the receiving water is found to be harmful. Tests were carried out on the fecal coliform values only since these are at present the bacteriological water quality indicators in the MOE "Blue Book" for water used for recreational purposes.

FIGURE 3.3  
PSEUDOMONAS AERUGINOSA RESULTS



Results of the ANOVA analysis indicated that variations in grey water quality between crews within boats were significant. Thus, crew selection could have confounded observed effects of boats and fixtures. While contributing significantly to the variability of the data, the lifestyle of the crews is a factor which is beyond regulatory control. The analysis further showed that there was a significant interaction between boats and fixtures with no single worst fixture or worst boat type. To elucidate this interaction, a series of one way analyses was performed.

The results of the one way comparisons between fixtures for each boat indicated that in the houseboat and the power boat, the galley sink exhibited the highest population density. In the sail boat the densities in all three fixtures were not significantly different. These results suggest that although the galley sink may be the largest contributor on some boat types, the trend is not constant across boats. Similarly, the relationship between the densities of the fecal coliforms in the head sink and the shower does not exhibit a constant pattern.

The results of the one-way comparisons between boats for each fixture indicated that the galley sink bacterial densities were highest in the house boat, with power and sail boats following in that order. However, for the head sink, the house boat densities were found to be highest, with the sail boat and the power boat following in that order. No significant difference was found among boats in the densities exhibited by shower water.

The log (10) mean fecal coliforms density across all boats and fixtures was 6.74, the corresponding log (10) variance was 1.20.

### 3.1.3 Water Usage

To determine the effects of pollutants on the receiving water, it is necessary to determine the loading of the contaminants discharged. For loading calculations, both concentration and flow data are required. This project included a component to determine the fresh water usage on the three pleasure boats studied.

In general, it may be assumed that all of the water supplied to the boat is eventually discharged as grey water, since losses due to drinking and cooking are minimal. Therefore, by measuring the volume of the water supplied, the total amount of grey



water produced can be estimated. This was done using a portable water meter connected to the supply hose during filling. Records were maintained by each of the crews on the volume of water supplied to the on board tanks during the period of the study.

Water use data were collected by each of the crews on the boats. Considerable variation in the water use was observed with the houseboat showing the lowest per capita usage in relation to the power and sail boats (Table 3.3). This may be attributable to either the lifestyles of the crews, but is more likely the result of limited water availability due to small water tanks on the houseboat used in the study. The actual volume of the tank was not available but supply was sufficiently limited to warrant one crew using purchased water in separate containers. Typical houseboat water use may therefore be higher than reflected in Table 3.3. Based on lifestyle considerations, BEAK believes that a value of 21 litres per person per day would be more typical for this type of boat.

Difficulties encountered with the equipment designed for the determination of the black water volumes prevented the collection of quantitative data on the volume of black water used on the boats by direct measurement. However, using pumpout frequencies, holding tank volumes and numbers of persons on board, an average black water generation rate of 10 litres per person per day was estimated. Based on these results, the rate of grey water production is in the range of 1.5 to 2 times the rate of black water production.

#### 3.1.4 Grey Water Chemical Characteristics

Samples collected from the boat fixtures were analysed for nine chemical and biochemical parameters to determine the concentrations of conventional contaminants and nutrients in the grey water (Table 3.4).

In summarizing the results, arithmetic means were calculated for the boats and the fixtures (Table 3.5). It is clear from the values shown in the table that the grey water contains high concentrations of total and suspended solids, ammonia, total Kjeldahl nitrogen and the phosphorus species when compared with the concentrations typically observed in raw domestic sewage. These high concentrations are commensurate with the fact that water use is reduced on pleasure boats because of the limited supply and because there is less to no dilution water from other household sources. It is also

TABLE 3.3:

FRESH WATER USAGE RESULTS  
(litres/person/day)

| <u>Crew</u> | <u>House<br/>Boat</u> | <u>Power<br/>Boat</u> | <u>Sail<br/>Boat</u> |
|-------------|-----------------------|-----------------------|----------------------|
| 1           | 4.8                   | 13.1                  | 13.3                 |
| 2           | -                     | 31.8                  | -                    |
| 3           | <u>6.9</u>            | <u>20.1</u>           | <u>19.9</u>          |
| Mean        | 5.9                   | 21.7                  | 16.6                 |



TABLE 3.4:

## GREY WATER CHEMICAL CHARACTERIZATION

| Sample Location        | Total Phosphorus (mg/l) | Soluble Phosphorus (mg/l) | Total Solids (mg/l) | Suspended Solids (mg/l) | BOD <sub>5</sub> (mg/l) | COD (mg/l) | TOC (mg/l) | Ammonia-N (mg/l) | TKN (mg/l) |
|------------------------|-------------------------|---------------------------|---------------------|-------------------------|-------------------------|------------|------------|------------------|------------|
| <b>SAILBOAT</b>        |                         |                           |                     |                         |                         |            |            |                  |            |
| GALLEYSINK             | 1                       | 0.26                      | 710                 | 100                     | 180                     | 1320       | 175        | 0.03             | 6.3        |
| GALLEYSINK             | 3.7                     | 3.2                       | 870                 | 116                     | 300                     | 1105       | 200        | 7.15             | 45         |
| GALLEYSINK             | 1.12                    | 0.83                      | 2100                | 61                      | 168                     | 520        | 140        | 0.07             | 10.1       |
| HEADSINK               | 1.015                   | 0.65                      | 400                 | 74.5                    | 120                     | 250        | 30         | 0.02             | 4.5        |
| HEADSINK               | 0.64                    | 0.35                      | 270                 | 140                     | 32                      | 350        | 21         | 0.01             | 2.9        |
| HEADSINK               | 1.65                    | 1.09                      | 350                 | 210                     | 60                      | 230        | 35         | 0.11             | 5.9        |
| SHOWER                 | 0.194                   | 0.004                     | 330                 | 142                     | 41                      | 330        | 9          | 3                | 5.9        |
| SHOWER                 | 0.3                     | 0.005                     | 290                 | 146                     | 21                      | 345        | 10         | 0.53             | 2.9        |
| SHOWER                 | 0.49                    | 0.005                     | 510                 | 148                     | 9.9                     | 920        | 70         | 1.17             | 9.3        |
| MEAN CONC.             | 1.12                    | 0.71                      | 647.78              | 126.39                  | 103.54                  | 596.67     | 76.67      | 1.34             | 10.52      |
| STANDARD ERROR OF MEAN | 0.336                   | 0.318                     | 182.674             | 14.074                  | 30.505                  | 128.714    | 23.563     | 0.750            | 4.255      |
| <b>POWERBOAT</b>       |                         |                           |                     |                         |                         |            |            |                  |            |
| GALLEYSINK             | 8.6                     | 6.3                       | 3800                | 2300                    | 1360                    | 2600       | 1330       | 21               | 51         |
| HEADSINK               | 1.18                    | 0.76                      | 5800                | 138                     | 120                     | 340        | 73         | 0.01             | 6.5        |
| SHOWER                 | 1.38                    | 1.02                      | 305                 | 37                      | 42                      | 117.5      | 22         | 9.9              | 17.4       |
| GALLEYSINK             | 27                      | 27                        | 2600                | 520                     | 920                     | 2100       | 1100       | 35               | 172        |
| HEADSINK               | 0.98                    | 0.35                      | 620                 | 220                     | 230                     | 390        | 100        | 0.03             | 5.2        |
| SHOWER                 | 5.45                    | 4.3                       | 650                 | 330                     | 129                     | 550        | 50         | 2.9              | 23/22      |
| GALLEYSINK             | 24                      | 25                        | 3300                | 2000                    | 1090                    | 3700       | 880        | 2.5              | 90         |
| HEADSINK               | 1.72                    | 1.1                       | 660                 | 380                     | 220                     | 650        | 180        | 0.01             | 16.8       |
| SHOWER                 | 8.3                     | 5.9                       | 530                 | 106                     | 102                     | 290        | 70         | 90               | 90         |
| MEAN CONC.             | 8.73                    | 7.97                      | 2029.44             | 670.11                  | 468.11                  | 1193.06    | 422.78     | 17.93            | 49.88      |
| STANDARD ERROR OF MEAN | 3.139                   | 3.293                     | 611.400             | 268.795                 | 159.337                 | 402.771    | 164.81     | 9.287            | 18.138     |
| <b>HOUSEBOAT</b>       |                         |                           |                     |                         |                         |            |            |                  |            |
| GALLEYSINK             | 16.3                    | 15.1                      | 4100                | 570                     | 2600                    | 4000       | 1920       | 4                | 117        |
| GALLEYSINK             | 2.4                     | 1.66                      | 670                 | 188.5                   | 590                     | 620        | 345        | 0.1              | 23         |
| HEADSINK               | 0.038                   | 0.014                     | 148                 | 11.5                    | 60                      | 67         | 7          | 0.05             | 0.34       |
| HEADSINK               | 0.38                    | 0.005                     | 610                 | 280                     | 140                     | 650        | 50         | 13.7             | 33         |
| SHOWER                 | 0.112                   | 0.004                     | 210                 | 17.6                    | 12.4                    | 87         | 13.5       | 2                | 8.7        |
| SHOWER                 | 0.86                    | 0.24                      | 650                 | 290                     | 430                     | 760        | 190        | 3.2              | 24         |
| GALLEYSINK             | 14.4                    | 13.9                      | 7700                | 2800                    | 410                     | 8900       | 6100       | 22               | 155        |
| HEADSINK               | 4.1                     | 2.4                       | 1390                | 830                     | 320                     | 850        | 320        | 0.05             | 33         |
| SHOWER                 | 0.27                    | 0.126                     | 510                 | 182                     | 69                      | 470        | 68         | 0.72             | 8.1        |
| MEAN CONC.             | 4.32                    | 3.72                      | 1776.44             | 574.40                  | 514.60                  | 1822.67    | 1001.50    | 5.09             | 44.68      |
| STANDARD ERROR OF MEAN | 2.015                   | 1.942                     | 795.046             | 274.783                 | 253.574                 | 913.891    | 629.857    | 2.407            | 15.913     |

important to consider that the values quoted in the table for domestic sewage are indicative of the observations at the inlet to a sewage treatment plant and therefore are inclusive of dilution by infiltration and industrial sources.

The significance of these concentrations on the receiving waters can be determined by identifying the loading which might be expected from boats. Using an assumed split of water use by fixture and estimates of the water use on each of the types of boats, the daily loading of each contaminant was calculated. These loadings were seen to be quite low and typically amount to less than 0.1 kilograms per day (Table 3.6).

## **3.2 Instream Sampling**

### **3.2.1 General**

The program of receiving water sampling carried out in this study was designed to quantify the effects of grey water discharges to the selected embayments (Chapter 2.0). The sampling locations were chosen because of their enclosed geography and their probable use by recreational boats. Agencies (MOE, MNR, Parks Canada) with knowledge of the locally popular anchorages in the South Georgian Bay and Central Trent Canal areas were consulted for assistance in selecting the sites.

Two sites in Southern Georgian Bay and one site in the Trent system were selected. In Georgian Bay both sites (Frying Pan Bay and Lost Bay) were located on the northern end of Beausoleil Island, approximately 20 kilometers from Midland (Figure 2.1). Each embayment is enclosed by headlands and is surrounded by essentially undeveloped land (Lost Bay has some limited cottage development on the western head land). The Trent Canal site (Blind Channel - Figure 2.2) was chosen based on information which indicated that it was frequently used as an anchorage by passing houseboats and because of its proximity to a boat launching site. The surrounding land was mainly agricultural or undeveloped.

### **3.2.2 Sample Collection**

As discussed in Section 2.0 samples were collected on a pre-determined schedule at each of the instream sampling locations. Samples were collected in the morning and evening

TABLE 3.5: MEAN VALUES GREY WATER CHEMICAL AND BIOCHEMICAL CHARACTERISTICS

| Sample Location | Total Phosphorus<br>(mg/l) | Soluble Phosphorus<br>(mg/l) | Total Solids<br>(mg/l) | Suspended Solids<br>(mg/l) | BOD <sub>5</sub><br>(mg/l) | COD<br>(mg/l) | TOC<br>(mg/l) | Ammonia-N<br>(mg/l) | TKN<br>(mg/l) |
|-----------------|----------------------------|------------------------------|------------------------|----------------------------|----------------------------|---------------|---------------|---------------------|---------------|
| BY BOAT         |                            |                              |                        |                            |                            |               |               |                     |               |
| Sail Boat       | 1.12                       | 0.71                         | 648                    | 126                        | 104                        | 597           | 77            | 1.3                 | 11            |
| Power Boat      | 8.73                       | 8.0                          | 2029                   | 670                        | 468                        | 1193          | 423           | 18                  | 50            |
| House Boat      | 4.32                       | 3.7                          | 1776                   | 574                        | 515                        | 1823          | 1002          | 5.1                 | 45            |
| BY FIXTURE      |                            |                              |                        |                            |                            |               |               |                     |               |
| Galley Sink     | 11                         | 10.4                         | 2872                   | 962                        | 846                        | 2763          | 1354          | 10.2                | 74            |
| Head Sink       | 1.30                       | 0.75                         | 1139                   | 254                        | 145                        | 420           | 91            | 1.6                 | 12            |
| Shower          | 1.93                       | 1.3                          | 443                    | 155                        | 95                         | 430           | 55            | 12.6                | 18.5          |
| RAW SEWAGE      |                            |                              |                        |                            |                            |               |               |                     |               |
| High            | 15                         | 10                           | 1200                   | 350                        | 400                        | 1000          | 290           | 50                  | 75            |
| Low             | 4                          | 3                            | 350                    | 100                        | 110                        | 250           | 80            | 12                  | 20            |

TABLE 3.6:

## GREY WATER DISCHARGE LOADINGS

| SAMPLE<br>SOURCE | PER CAPITA<br>WATER USE<br>(l/c/d) | NUMBER OF<br>PERSONS | TOTAL<br>PHOSPHORUS<br>(kg/d) | SOLUBLE<br>PHOSPHORUS<br>(kg/d) | TOTAL<br>SOLIDS<br>(kg/d) | SUSPENDED<br>SOLIDS<br>(kg/d) | BOD <sub>5</sub><br>(kg/d) | COD<br>(kg/d) | TOC<br>(kg/d) | AMMONIA-N<br>(kg/d) | TKN<br>(kg/d) |
|------------------|------------------------------------|----------------------|-------------------------------|---------------------------------|---------------------------|-------------------------------|----------------------------|---------------|---------------|---------------------|---------------|
| BY BOAT          |                                    |                      |                               |                                 |                           |                               |                            |               |               |                     |               |
| SAIL BOAT        | 17                                 | 4                    | 0.0004                        | 0.0004                          | 0.1216                    | 0.0387                        | 0.0321                     | 0.1058        | 0.0474        | 0.0006              | 0.0030        |
| POWER BOAT       | 22                                 | 4                    | 0.0005                        | 0.0005                          | 0.1590                    | 0.0506                        | 0.0419                     | 0.1383        | 0.0620        | 0.0008              | 0.0039        |
| HOUSE BOAT       | 20                                 | 6                    | 0.0008                        | 0.0007                          | 0.2198                    | 0.0700                        | 0.0580                     | 0.1913        | 0.0857        | 0.0010              | 0.0054        |

Saturday, Sunday and Monday on two weekends. One of these weekends coincided with the August 1 long weekend and reflected a high boat traffic situation. The second weekend, August 8, could be considered a normal summer period weekend for boat traffic.

Samples were collected from the water surface at a depth of approximately 1 metre from 10 stations located over the entire area of the embayments. In addition, a background location was selected away from the anchorage area so that the unaffected bacterial density could be determined.

Drogues were deployed during the sampling events to identify the presence of currents. In all three embayments the drogue behaviour indicated the presence of low velocity currents but significant exchange flow relative to the volumes of the embayments.

The number of boats of each variety was enumerated during each sampling event and is presented in Table 3.7. Unfortunately it was not possible to determine the presence of a shower fixture by visual external inspections, hence sailboats and power boats were not distinguished between types A and B. The table shows that boat usage of Blind Channel was relatively light when compared to Lost Bay and Frying Pan Bay. As expected, all three locations in the second weekend of sampling were less heavily used than the first.

### 3.2.3 Data Analysis

The instream bacterial population densities were determined on the samples collected in each of the sampling events for fecal coliform, E. coli and Pseudomonas aeruginosa (Appendix A). To characterize the water quality of each of the embayments during each of the sampling events, the geometric mean of the bacterial densities from all 10 embayment sampling points was used. It is standard practice to use a geometric mean since bacterial data is log normally distributed. In this way a single number was generated for use in subsequent analyses of the embayment data (Table 3.8). Also in the table are the values of the bacterial densities found at the background locations near the embayments. In general, these locations were chosen to be largely unaffected by the water quality of the embayment being sampled or any other anthropogenic sources of bacteria.

TABLE 3.7:

## BOAT USAGE WITHIN SAMPLED EMBAYMENTS

| Day       | Sampling Time <sup>1</sup> | Event No. | BLIND CHANNEL |             |            | LOST BAY    |             |             | FRYING PAN BAY |             |             | Total Boats |             |            |
|-----------|----------------------------|-----------|---------------|-------------|------------|-------------|-------------|-------------|----------------|-------------|-------------|-------------|-------------|------------|
|           |                            |           | House Boats   | Power Boats | Sail Boats | Total Boats | House Boats | Power Boats | Sail Boats     | Total Boats | House Boats |             | Power Boats | Sail Boats |
| Weekend 1 |                            |           |               |             |            |             |             |             |                |             |             |             |             |            |
| Sat.      | a.m.                       | 1         | 5             | 1           | 0          | 6           | 2           | 5           | 5              | 12          | 0           | 19          | 1           | 20         |
| Sat.      | p.m.                       | 2         | 5             | 2           | 2          | 9           | 2           | 8           | 12             | 22          | 1           | 19          | 5           | 25         |
| Sun.      | a.m.                       | 3         | 5             | 1           | 0          | 6           | 3           | 5           | 24             | 24          | 0           | 23          | 3           | 26         |
| Sun.      | p.m.                       | 4         | 3             | 3           | 0          | 6           | 2           | 5           | 24             | 24          | 0           | 20          | 7           | 27         |
| Mon.      | a.m.                       | 5         | 3             | 1           | 0          | 4           | 2           | 6           | 24             | 24          | 1           | 27          | 8           | 36         |
| Mon.      | p.m.                       | 6         | 3             | 1           | 0          | 3           | 0           | 2           | 3              | 3           | 0           | 10          | 4           | 14         |
| Weekend 2 |                            |           |               |             |            |             |             |             |                |             |             |             |             |            |
| Sat.      | a.m.                       | 7         | 3             | 0           | 0          | 3           | 0           | 4           | 6              | 10          | 3           | 13          | 5           | 21         |
| Sat.      | p.m.                       | 8         | 3             | 0           | 0          | 3           | 0           | 10          | 18             | 28          | 0           | 28          | 5           | 33         |
| Sun.      | a.m.                       | 9         | 3             | 0           | 0          | 3           | 0           | 8           | 18             | 26          | 0           | 21          | 4           | 25         |
| Sun.      | p.m.                       | 10        | 6             | 0           | 0          | 6           | 0           | 3           | 3              | 6           | 0           | 9           | 6           | 15         |
| Mon.      | a.m.                       | 11        | 6             | 0           | 0          | 6           | 0           | 2           | 1              | 3           | 0           | 6           | 4           | 10         |
| Mon.      | p.m.                       | 12        | 3             | 1           | 0          | 4           | 0           | 3           | 4              | 7           | 0           | 10          | 2           | 12         |

<sup>1</sup> Sampling times were standardized as AM or PM. AM sampling was generally conducted between 08:00 and 09:00 hrs. PM sampling was generally conducted between 18:00 and 19:00 hrs.

TABLE 3.8:

## EMBAYMENT BACTERIAL ANALYSES

## BLIND CHANNEL

| Event No. | FECAL COLIFORM               |                          | E. COLI                      |                          | P. AERUGINOSA                |                          |
|-----------|------------------------------|--------------------------|------------------------------|--------------------------|------------------------------|--------------------------|
|           | Geometric Mean<br>(#/100 ml) | Background<br>(#/100 ml) | Geometric Mean<br>(#/100 ml) | Background<br>(#/100 ml) | Geometric Mean<br>(#/100 ml) | Background<br>(#/100 ml) |
| 1         | 4                            | 2                        | 2                            | 2                        | 1                            | 1                        |
| 2         | 7                            | 80                       | 3                            | 1                        | 1                            | 1                        |
| 3         | 4                            | 1                        | 1                            | 1                        | 1                            | 1                        |
| 4         | 3                            | 76                       | 3                            | 70                       | 1                            | 1                        |
| 5         | 3                            | 2                        | 2                            | 2                        | 1                            | 1                        |
| 6         | 6                            | 36                       | 4                            | 26                       | 1                            | 1                        |
| 7         | 1                            | 2                        | 1                            | 2                        | 1                            | 1                        |
| 8         | 2                            | 1                        | 2                            | 1                        | 1                            | 1                        |
| 9         | 2                            | 1                        | 2                            | 1                        | 2                            | 1                        |
| 10        | 1                            | 1                        | 1                            | 1                        | 1                            | 1                        |
| 11        | 1                            | 2                        | 1                            | 2                        | 1                            | 1                        |
| 12        | 2                            | 2                        | 1                            | 2                        | 1                            | 2                        |

## FRYING PAN BAY

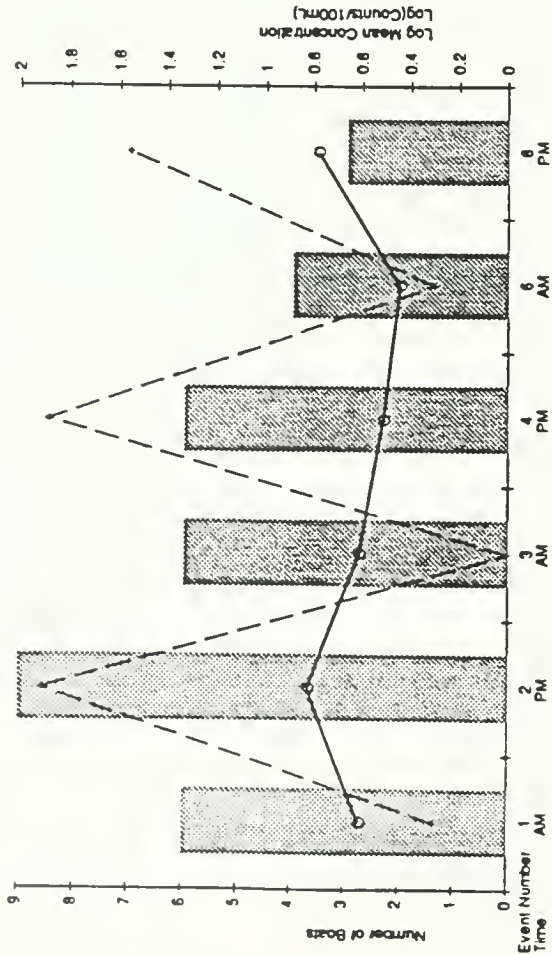
|    |     |    |     |    |     |       |
|----|-----|----|-----|----|-----|-------|
| 1  | 51  | 4  | 17  | 1  | 54  | 9     |
| 2  | 163 | 1  | 81  | 1  | 37  | 48    |
| 3  | 293 | 2  | 108 | 1  | 89  | 41    |
| 4  | 189 | 28 | 45  | 28 | 21  | 44    |
| 5  | 203 | 10 | 71  | 10 | 16  | 2     |
| 6  | 360 | 29 | 204 | 20 | 9   | 1     |
| 7  | 50  | 7  | 29  | 6  | 1   | 1     |
| 8  | 90  | 19 | 26  | 3  | 505 | 400   |
| 9  | 103 | 6  | 47  | 4  | 38  | 220   |
| 10 | 75  | 4  | 21  | 2  | 171 | 60    |
| 11 | 64  | 6  | 21  | 2  | 328 | 1,180 |
| 12 | 89  | 34 | 44  | 15 | 88  | 220   |

## LOST BAY

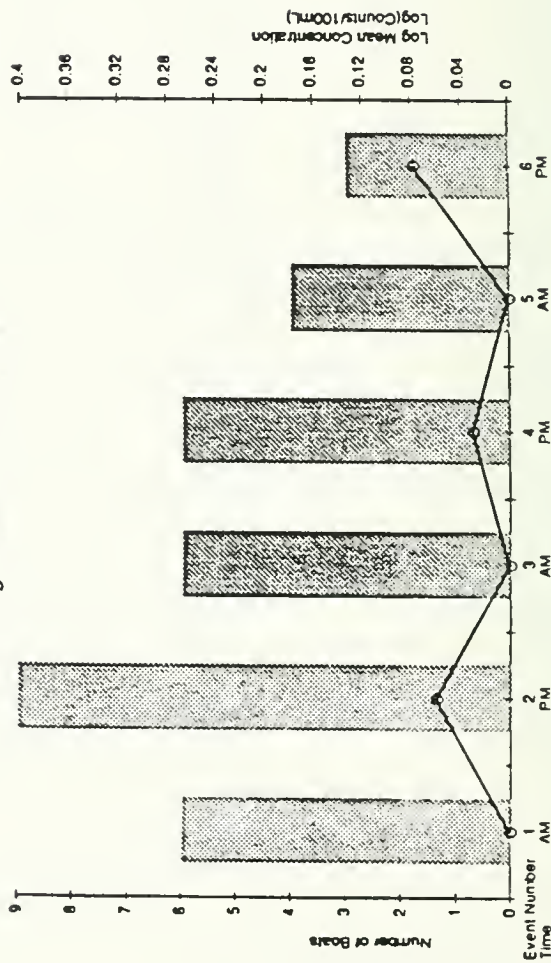
|    |     |     |    |    |     |      |
|----|-----|-----|----|----|-----|------|
| 1  | 7   | 2   | 4  | 2  | 23  | 2    |
| 2  | 7   | 2   | 3  | 2  | 49  | 42   |
| 3  | 109 | 2   | 74 | 2  | 214 | 56   |
| 4  | 91  | 34  | 59 | 17 | 14  | 7    |
| 5  | 105 | 2   | 57 | 2  | 17  | 2    |
| 6  | 40  | 2   | 38 | 2  | 1   | 1    |
| 7  | 35  | 2   | 18 | 2  | 2   | 2    |
| 8  | 31  | 48  | 15 | 10 | 213 | 200  |
| 9  | 23  | 1   | 15 | 1  | 20  | 77   |
| 10 | 23  | 2   | 17 | 1  | 232 | 210  |
| 11 | 13  | 2   | 9  | 2  | 140 | 1050 |
| 12 | 43  | 106 | 11 | 14 | 58  | 156  |



Fecal Collorm In Blind Channel



P. Aeruginosa In Blind Channel



E. Coll In Blind Channel

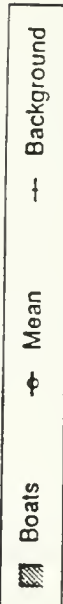
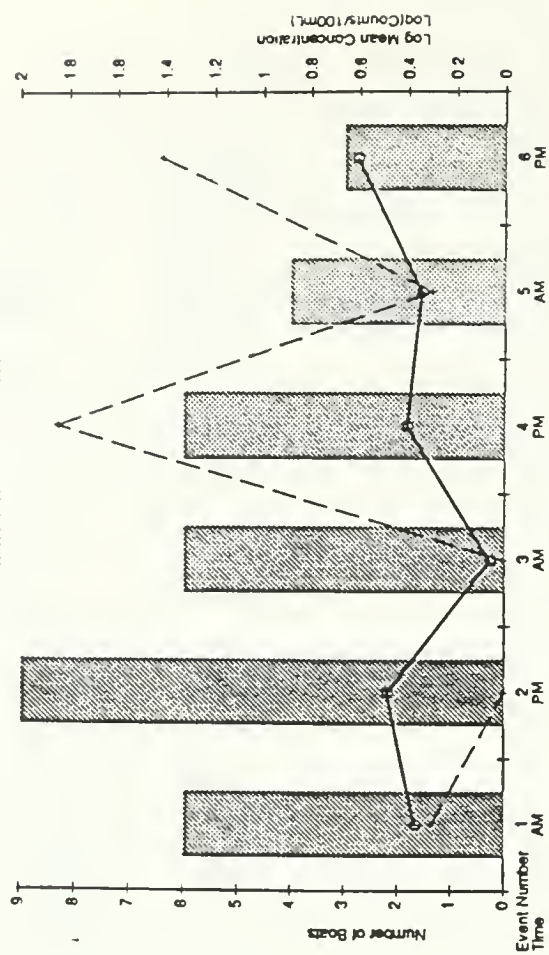
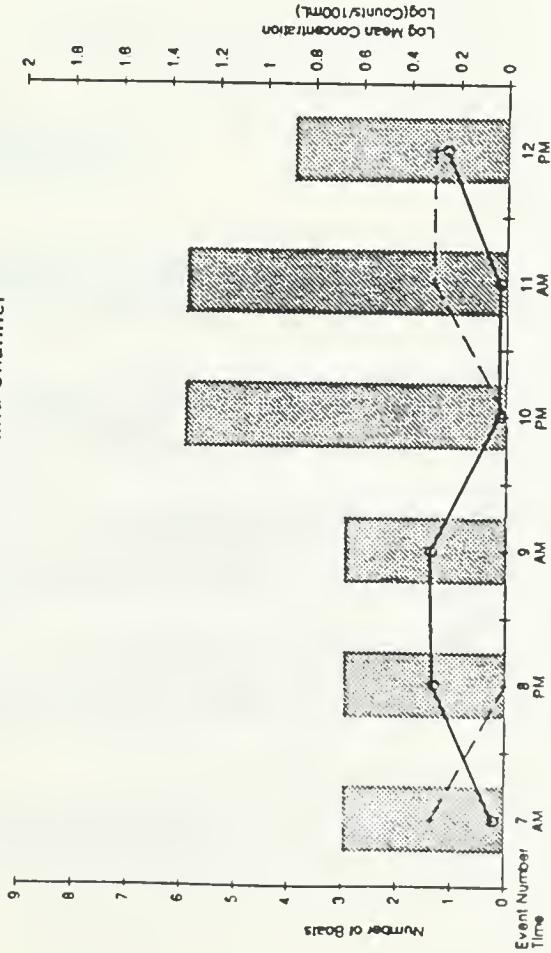


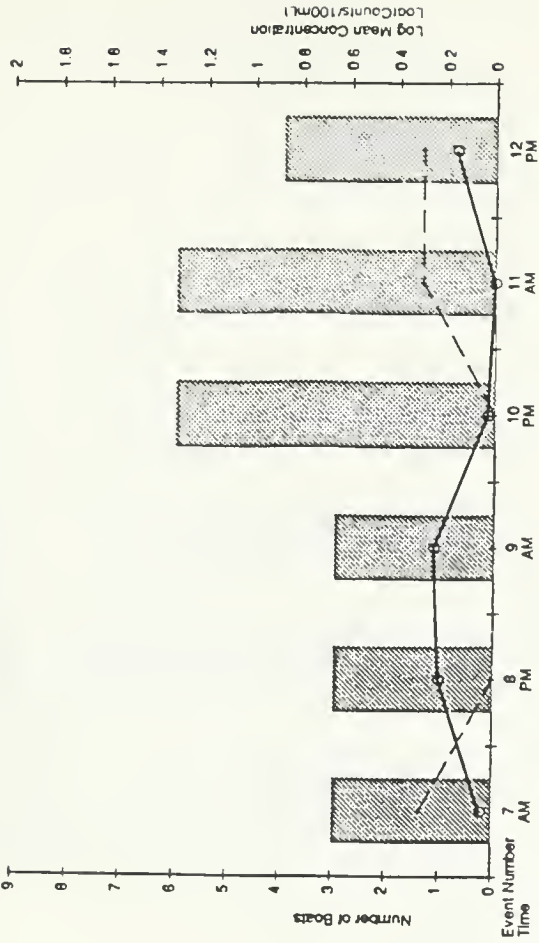
FIGURE 3.4  
Blind Channel Results-  
Weekend Number 1



Fecal Colliform In Blind Channel



E. Coll. In Blind Channel



P. Aeruginosa In Blind Channel

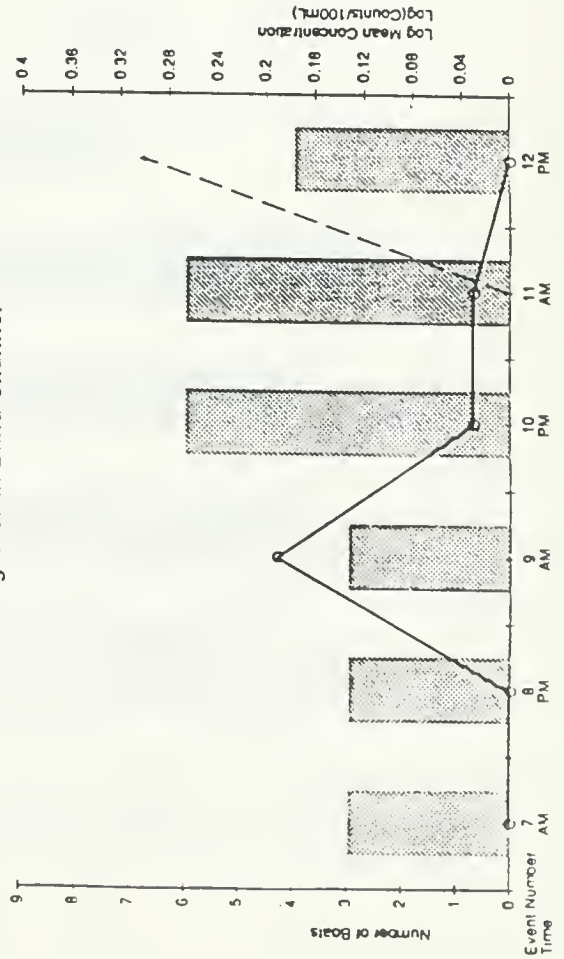
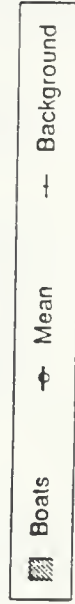
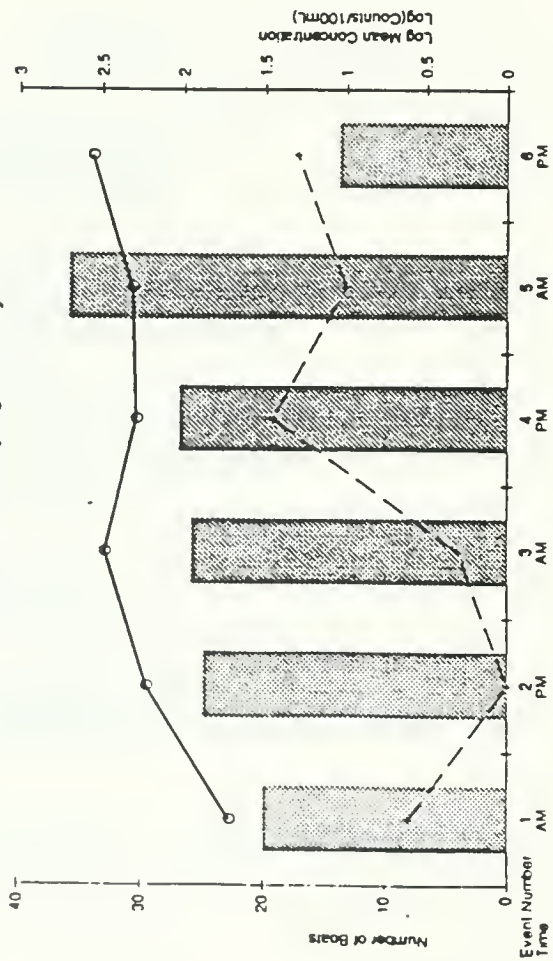


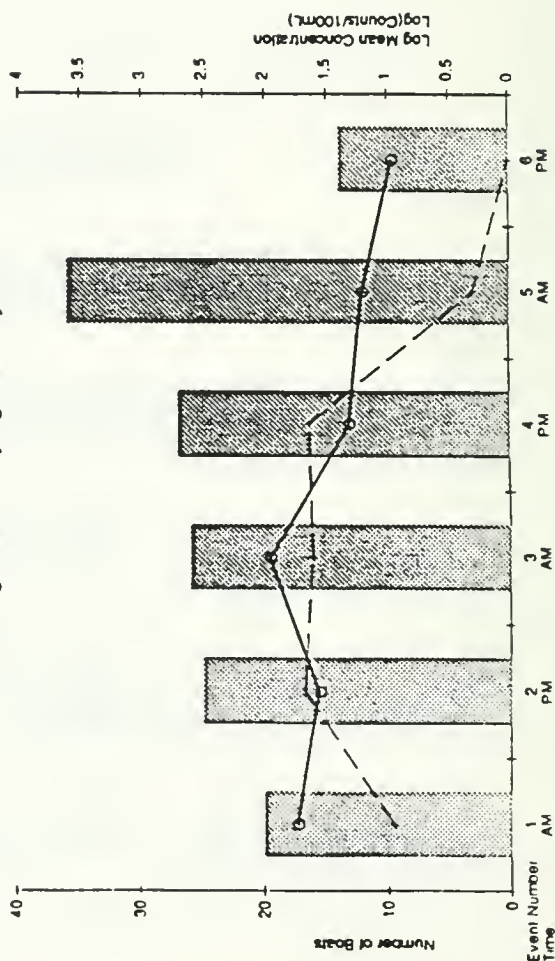
FIGURE 3.5  
Blind Channel Results-  
Weekend Number 2



Fecal Collform In Frying Pan Bay



P. Aeruginosa In Frying Pan Bay



E. Coll. In Frying Pan Bay

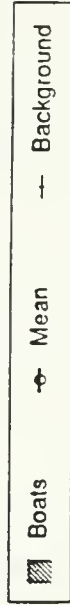
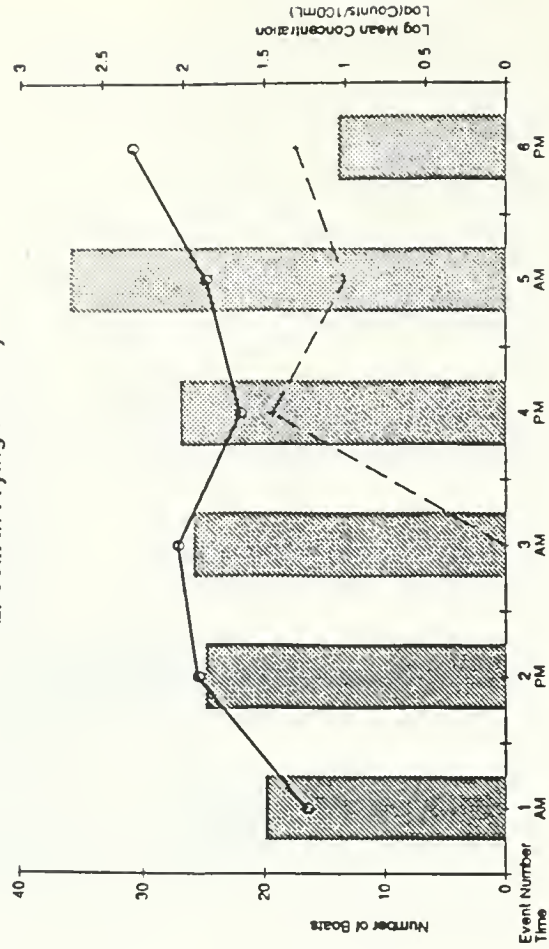
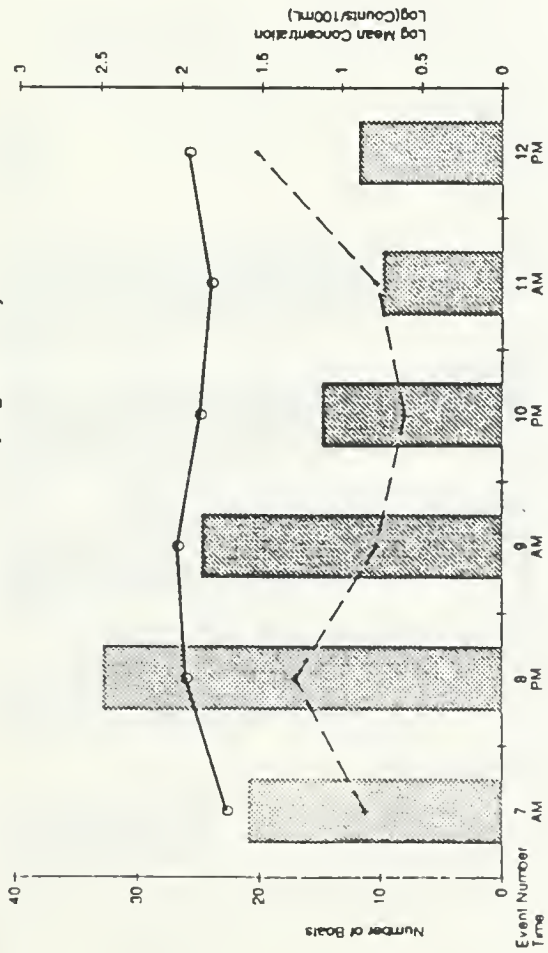
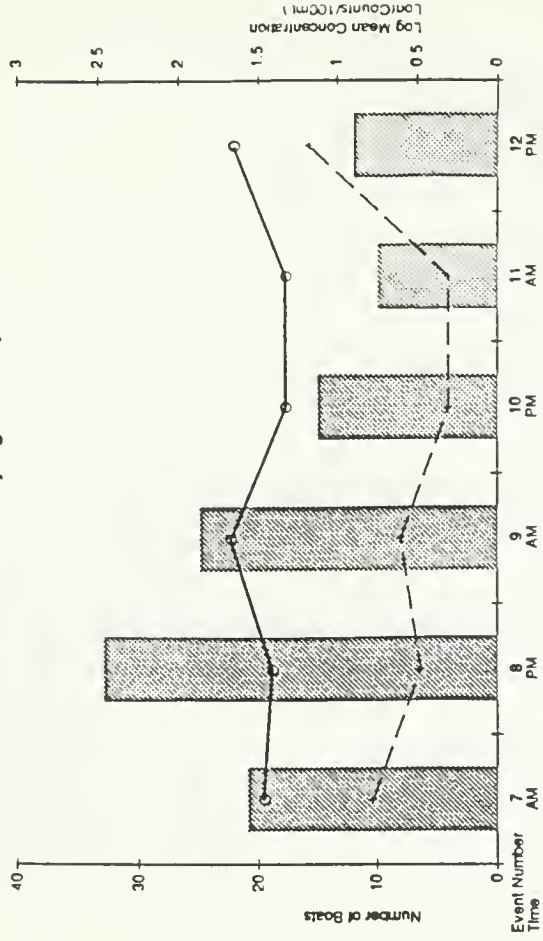


FIGURE 3.6  
Frying Pan Bay Results-  
Weekend Number 1

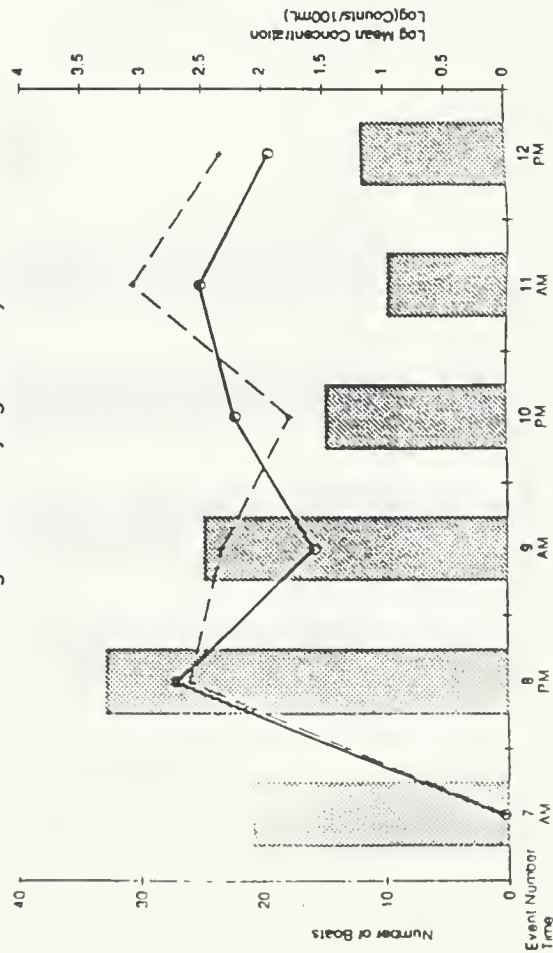
### Fecal Collform In Frying Pan Bay



### E. Coll. In Frying Pan Bay



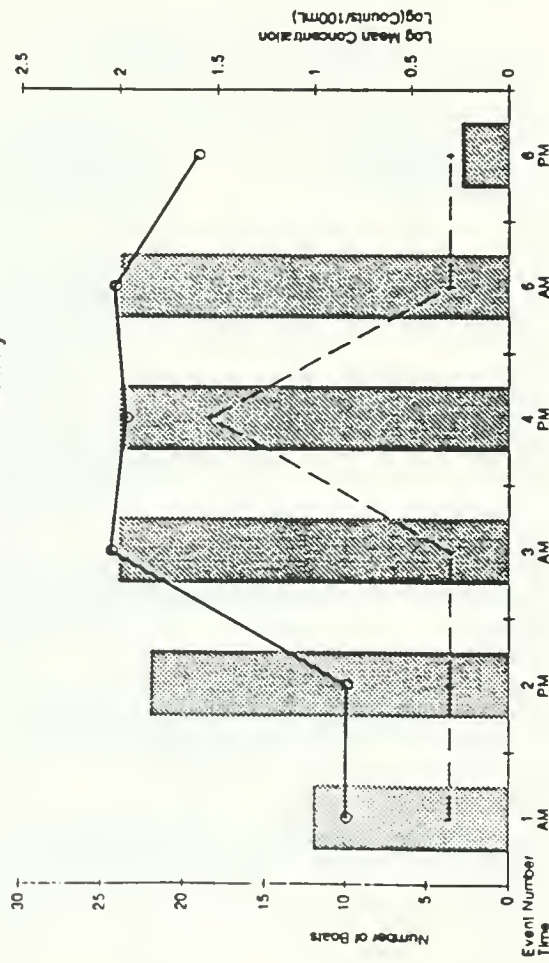
### P. Aeruginosa In Frying Pan Bay



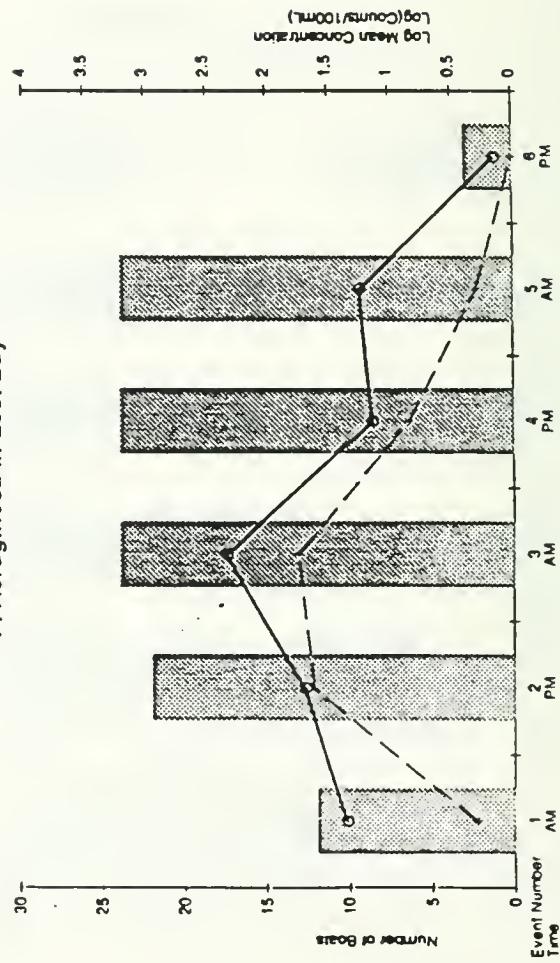
**FIGURE 3.7**  
Frying Pan Bay Results-  
Weekend Number 2



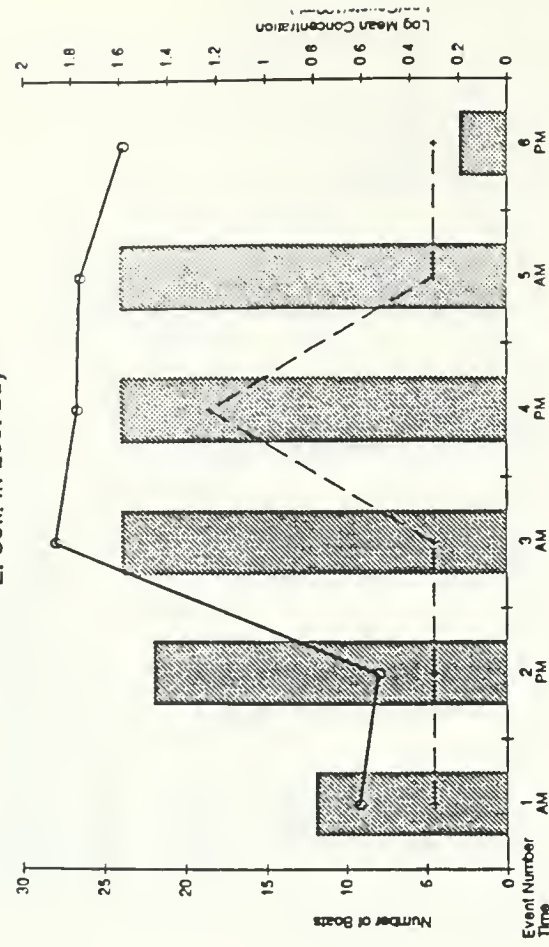
### Fecal Colliform In Lost Bay



### P. Aeruginosa In Lost Bay

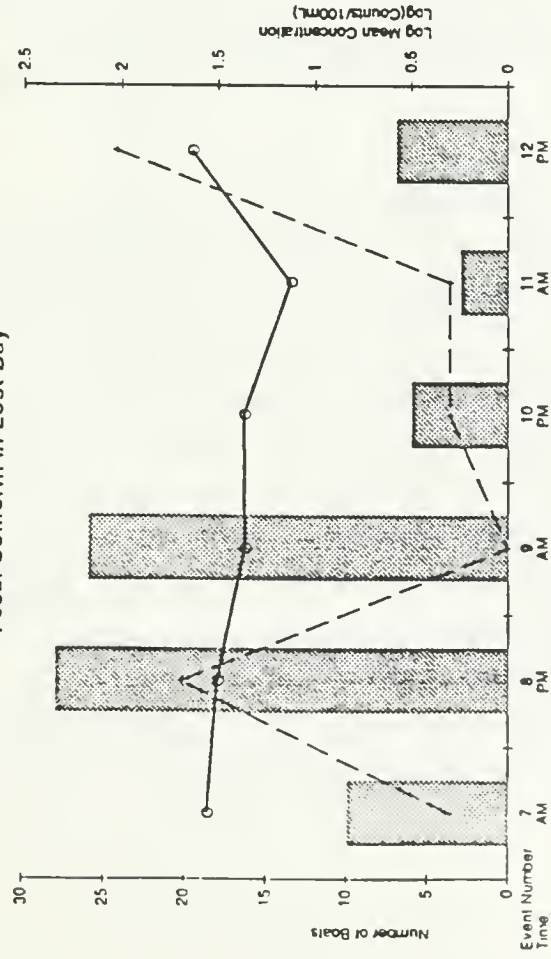


### E. Coll. In Lost Bay

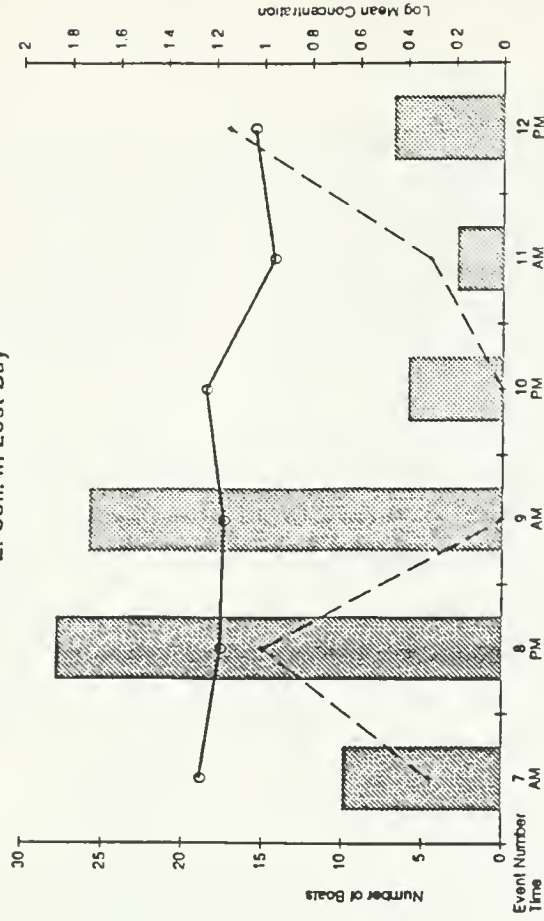


**FIGURE 3.8**  
Lost Bay Results-  
Weekend Number 1

Fecal Colliform In Lost Bay



E. Coll. In Lost Bay



P. Aeruginosa In Lost Bay

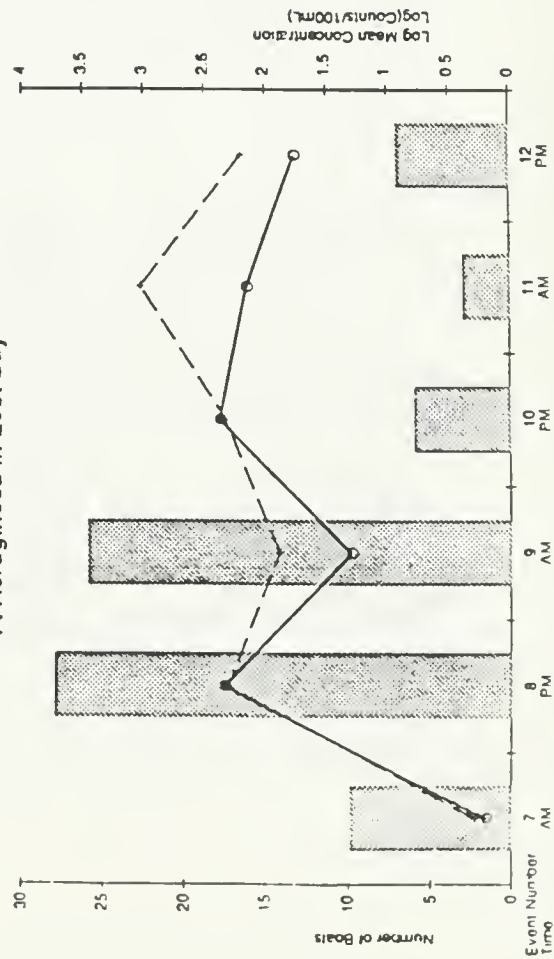


FIGURE 3.9  
Lost Bay Results-  
Weekend Number 2

The results of the embayment sampling were plotted along with the number of boats in the embayments at the time of the sampling, to determine the possibility of simple statistical relationships between the various bacteria and the number of boats (Figures 3.4 to 3.9). In Blind Channel there appears to be no relationship between the number of boats and the bacterial densities for any of the species tested. The density values were low and the background station values were erratic for the fecal and E. coli densities.

In Frying Pan Bay the densities for fecal coliform at times exceeded the MOE Blue Book recreational water quality guideline of 100 organisms per 100 ml on a series of samples. The highest values were found when many boats were present and therefore a relationship is suggested. Similarly, a relationship appears likely for the E. coli densities and the number of boats. This could be expected since E. coli frequently behave similarly to fecal coliform. In the case of both species however, the background densities drifted markedly making it difficult to draw any definitive conclusion.

The fecal and E. coli densities in Lost Bay behave in a similar fashion to those in Frying Pan Bay, especially during the first weekend. In addition, in Lost Bay the Pseudomonas aeruginosa densities suggest a relationship until the wide variation in the background station is considered. The wide variation in Pseudomonas aeruginosa data suggests that some other factors may be causing the observed fluctuations in the Pseudomonas aeruginosa density within the bay.

The previously discussed figures do not consistently demonstrate a reliable simple relationship between the number of boats in an embayment and the bacterial densities observed. In the figures which do suggest a relationship, the conclusion is confounded by the variance of the background results. To further explore the existence of simple statistical relationships between these results the log bacterial densities were correlated against the number of boats in the embayment at the time of sampling. Regressions were carried out on the fecal coliform results only, since the MOE Blue Book recreational water quality objective is formulated in terms of this group of organisms. The data suggests that the E. coli behaves in a fashion similar to the fecal coliform, suggesting that the results of a regression would be similar to that for fecals. The geometric mean densities of each of the bacteria species was correlated against the number of boats present in each embayment at the time of sample collection in an effort to determine if any simple statistical relationship existed between them.



**FIGURE 3-10 BLIND CHANNEL  
FECAL COLIFORMS VS BOATS**

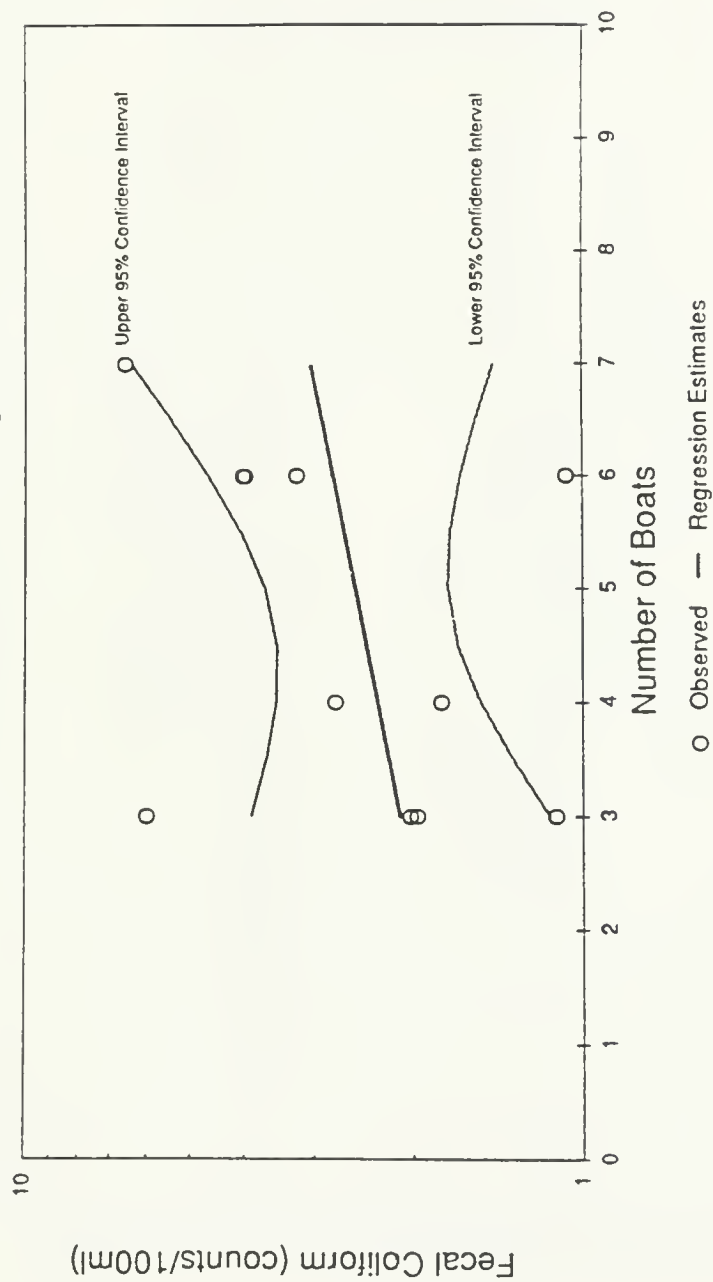


FIGURE 3-11 FRYING PAN BAY  
FECAL COLIFORMS VS BOATS

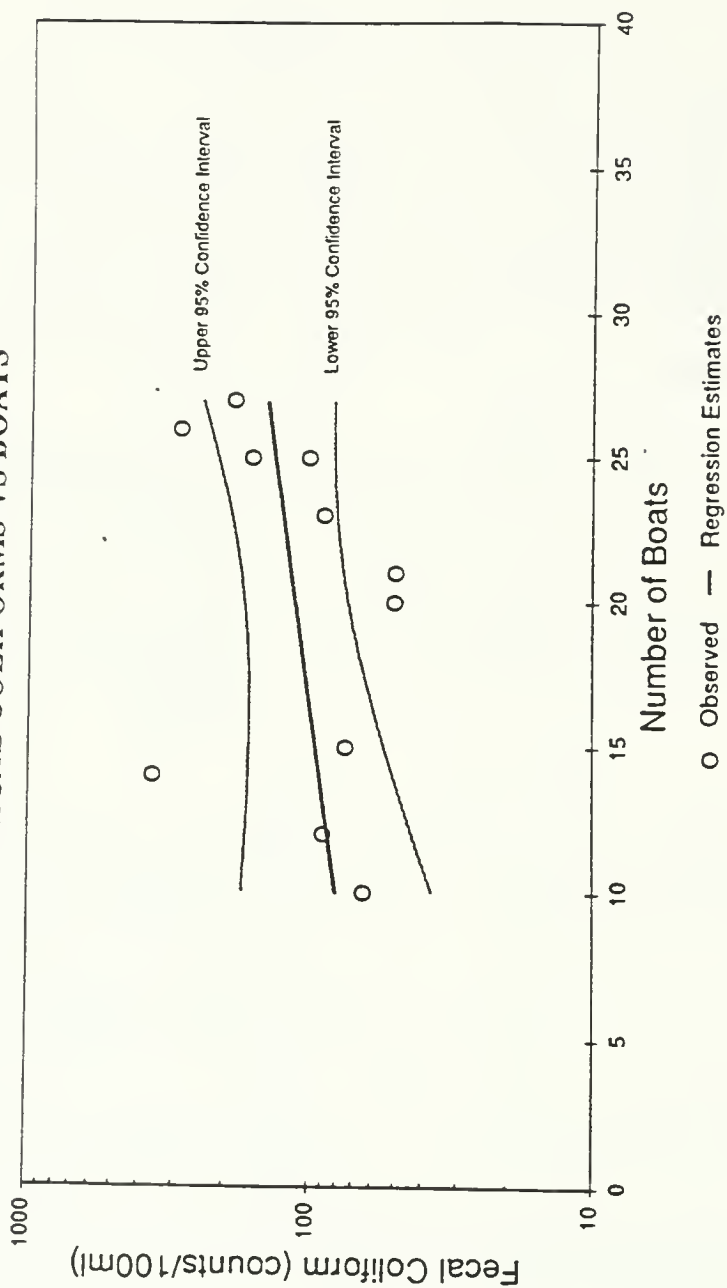
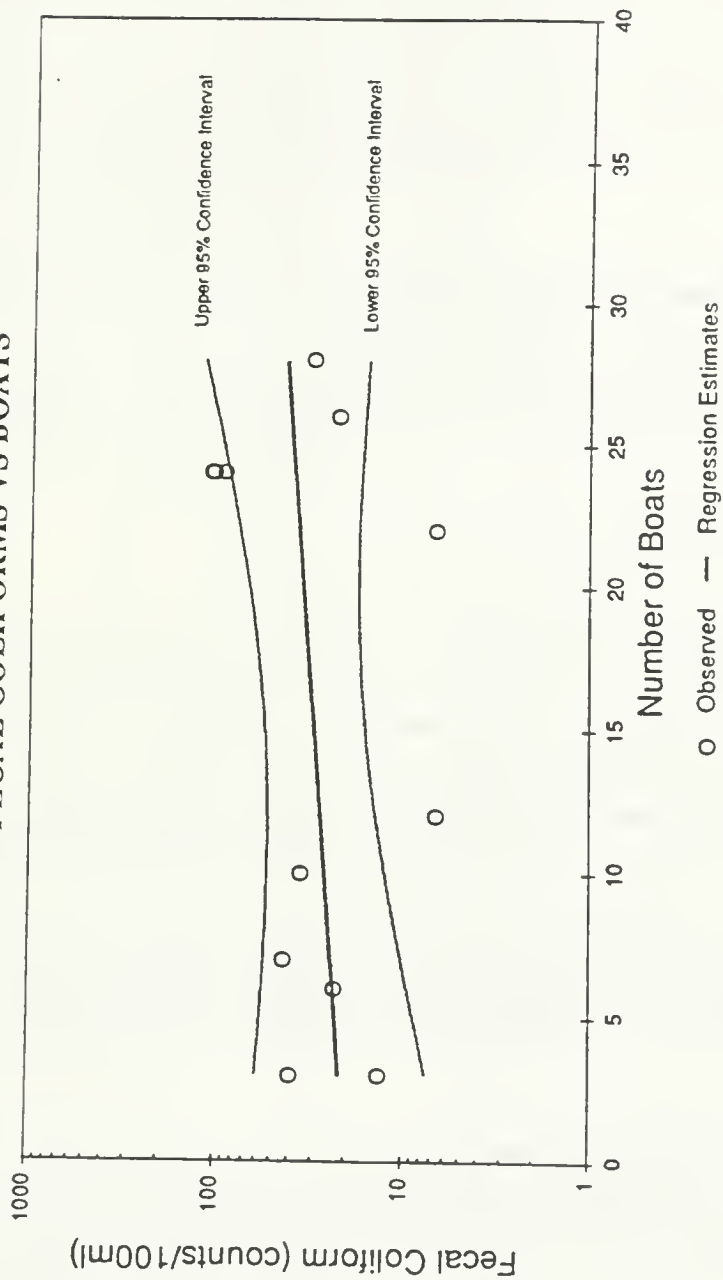


FIGURE 3-12 LOST BAY  
FECAL COLIFORMS VS BOATS



The results of the regressions carried out on the fecal coliform data for the three embayments are shown in Figures 3.10 to 3.12. To determine the significance of the apparent relationships, the slopes were tested for significant difference from zero and the correlation coefficients were tested for significance. It was found that none of the slopes was significantly different from zero. This implies that a straight, horizontal line on the figures represents a suitable depiction of the relationship. That is, there is no statistical relationship between the two parameters. Similarly, the correlation coefficients calculated for E. coli and Pseudomonas aeruginosa were also found to be insignificant, implying that the bacterial densities and boat numbers were not related.

Based on simple statistical correlations of the embayment data, it appears appropriate to conclude that no simple relationship exists between the number of boats and the embayment water quality. Notwithstanding this, the data for Frying Pan Bay clearly suggests that fecal coliform densities increased during the two periods of sampling and that levels exceeded the recreational use water quality guideline at certain times.

#### 3.2.4 Embayment Model

The statistical treatment described above attempted to account for all the variability in the embayment water quality as a function of the number of boats alone. That is, the effects of the temporal variation of the background bacterial concentration, the natural die-off of bacteria, the exchange associated with ambient water movements into and out of the embayments are implied by the above statistical procedures to be insignificant. In practice, it is probable that they are important in some situations. To account for the variability of bacteria densities in relation to these parameters it is necessary to make estimates of their effects. This can be done through exploratory modelling to identify whether or not they play an important role in determining the observed embayment bacterial densities.

To explore the relationship between boat density and bacterial water quality a deterministic model was developed relating surface water quality in the embayments to the volume of the embayment, the background bacterial water quality, exchange flow between the embayment and surrounding waters, bacterial die-off, and bacterial loadings due to boat activities. The model assumes that there is sufficient energy in the wind and exchange flow to induce lateral mixing of the surface water within the basin over a period of several hours. This assumption is born out by the drift drogue data which

showed net movements of up to several hundred metres over the course of a few hours. The only source of bacteria within the embayments was assumed to be the boats. This ignores any input from shore based activity, other water based sources (e.g., water fowl and mammals) and sediment bacterial processes which, although not measured in this study, are known to be non zero. Hence, the analysis is conservative relative to the impact of boat bacterial loadings.

The form of the model is as follows:

$$V \frac{dC}{dt} = Q_e(C_b - C) - KVC + L \quad (1)$$

where: C is the concentration of bacteria in the embayment at time t (cnts/100ml),  
 $\frac{dC}{dt}$  is the change in concentration of bacteria with time (cnts/100 ml/day)  
V is the volume of the embayment ( $m^3$ )  
 $C_b$  is the background concentration of bacteria (cnts/100ml)  
 $Q_e$  is the exchange flow ( $m^3$ /day)  
K is the first order bacterial die-off coefficient (per day)  
t is the elapsed time (days)  
L is the loading of bacteria to the embayment (cnts/day)

Equation (1) may be solved to give the concentration in the embayment at any time (t) as a function of the parameters in the model.

The model was applied to both Frying Pan Bay and Lost Bay over the two three day sampling periods August 1,2,3 (Weekend 1); and August 8,9,10 (Weekend 2). The physical characteristics of volume and exchange flow were estimated from nautical charts and qualitative drogue data respectively. Background concentrations were assumed to be as measured during each of the daily AM and PM samplings. A value of 0.25 per day was assumed for the first order die-off coefficient. The following relationships were used to relate observed boat densities to an equivalent bacterial loading:

log cnts/100ml

log mean grey water fecal coliform concentration  
over all boats and all fixtures 6.74

log standard error of grey water fecal coliform  
concentration over all boats and all fixtures 1.20

cnts/100 ml

geometric mean fecal coliform concentration + standard error  $8.8 \times 10^7$   
geometric mean - fecal coliform concentration - standard error  $3.5 \times 10^5$

| <u>Boat<br/>Type</u> | <u>Assumed<br/>Water Use<br/>(l/c/day)</u> | <u>Assumed<br/>No. People</u> | <u>Total Water Use<br/>(l/day)</u> |
|----------------------|--|-------------------------------|------------------------------------|
| Sail                 | 16.6                                       | 4                             | 66.4                               |
| Power                | 21.7                                       | 4                             | 86.8                               |
| Houseboat            | 21*  | 6                             | 126                                |

- \* measured value of was 6 l/c/day but was thought to be unreliable as discussed in section 3.1.3 above, 21 l/c/day is, in Beak's estimate, a more reasonable estimate of consumption and is conservative for the purposes of modelling.

Using the above estimates of fecal coliform density (geometric mean +/- standard error) and the daily estimates of water use, estimates of fecal coliform loadings by boat were calculated using the following equation:

$$\text{bacterial loading} = (\text{daily water use}) \times (\text{bacterial density})$$



| <u>Boat</u>  | <u>Maximum Load</u><br>(cnts/day) | <u>Minimum Load</u><br>(cnts/day) |
|--|-----------------------------------|-----------------------------------|
| Sail   | $5.84 \times 10^{10}$             | $2.33 \times 10^8$                |
| Power  | $7.64 \times 10^{10}$             | $3.04 \times 10^8$                |
| Houseboat  | $1.11 \times 10^{11}$             | $4.42 \times 10^8$                |
|  |                                   |                                   |
| overall maximum load, Lmax (cnts/boat/day) $1.11 \times 10^{11}$ |                                   |                                   |
| overall minimum load, Lmin (cnts/boat/day) $2.33 \times 10^8$    |                                   |                                   |

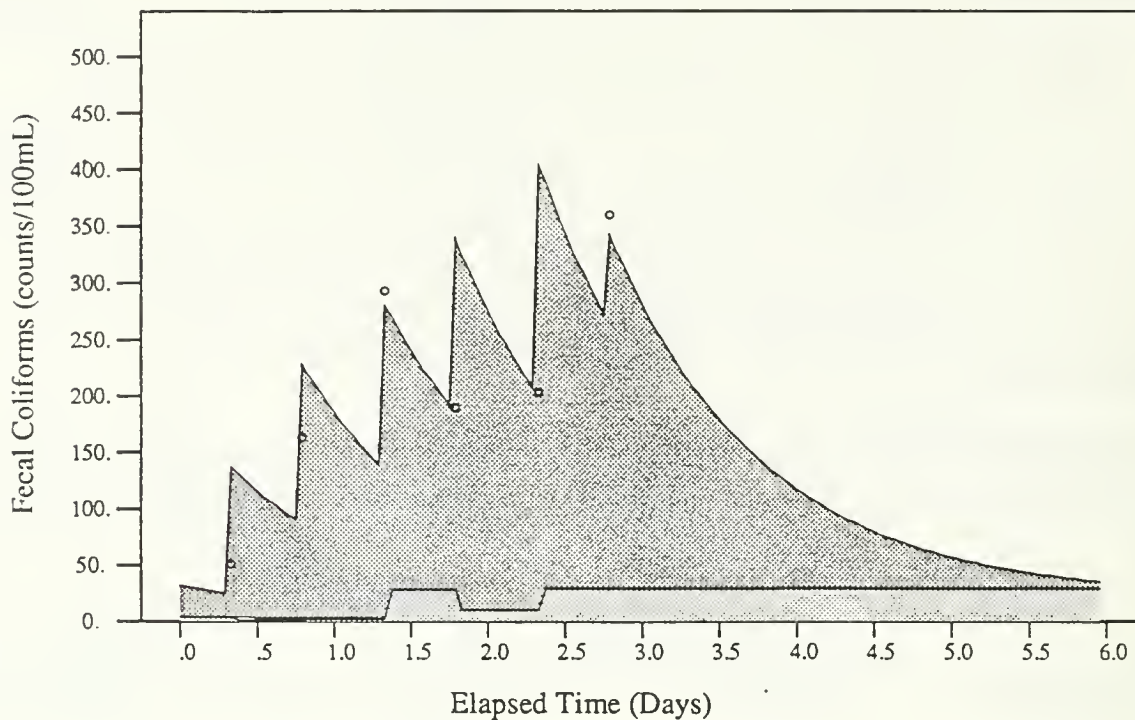
Boat densities observed in Frying Pan Bay and Lost Bay at approximately 08:00 hrs. (AM) and 18:00 hrs. (PM) on the days of sampling are presented as follows:

| OBSERVED BOATS        |    |           |           |                 |    |
|-----------------------|----|-----------|-----------|-----------------|----|
| <u>Frying Pan Bay</u> |    |           |           | <u>Lost Bay</u> |    |
| Weekend 1             |    | Weekend 2 | Weekend 1 | Weekend 2       |    |
| Sat                   | AM | 20        | 21        | 12              | 10 |
|                       | PM | 25        | 23        | 22              | 28 |
| Sun                   | AM | 26        | 25        | 24              | 26 |
|                       | PM | 27        | 15        | 24              | 6  |
| Mon                   | AM | 36        | 10        | 24              | 3  |
|                       | PM | 14        | 12        | 12              | 7  |

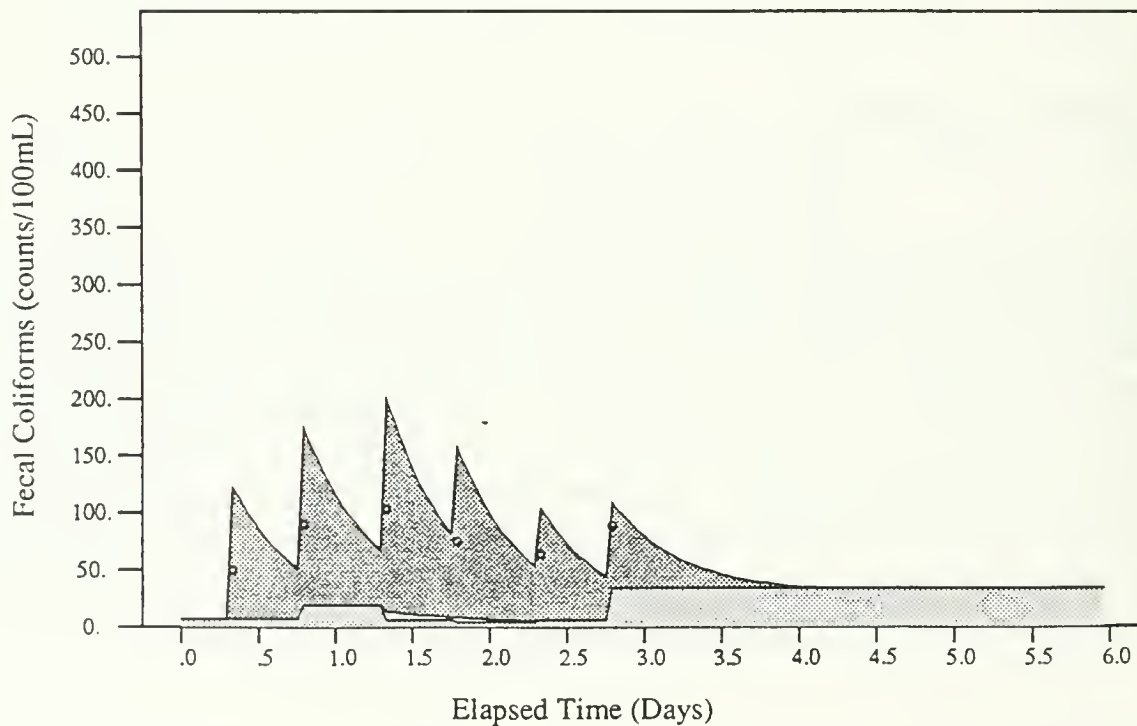
These observed boat densities were combined with the maximum and minimum bacterial loading estimates developed above to give corresponding ranges of daily loading. This analysis is generic as it does not consider variations in the loading which would be expected because of differences in both the types of boats present in the embayments and the variations in number of people per boat as compared to the greywater bacterial characteristics of the boats in the onboard portion of this study. The loadings were assumed to enter the embayment water within a short period of time around the period of sampling. This is a reasonable assumption given that the major volumes of grey water are typically generated during discrete events in the morning and evening.

FIGURE 3-13

FRYING PAN BAY, AUGUST 1-3  
FECAL COLIFORMS



FRYING PAN BAY, AUGUST 8-10  
FECAL COLIFORMS



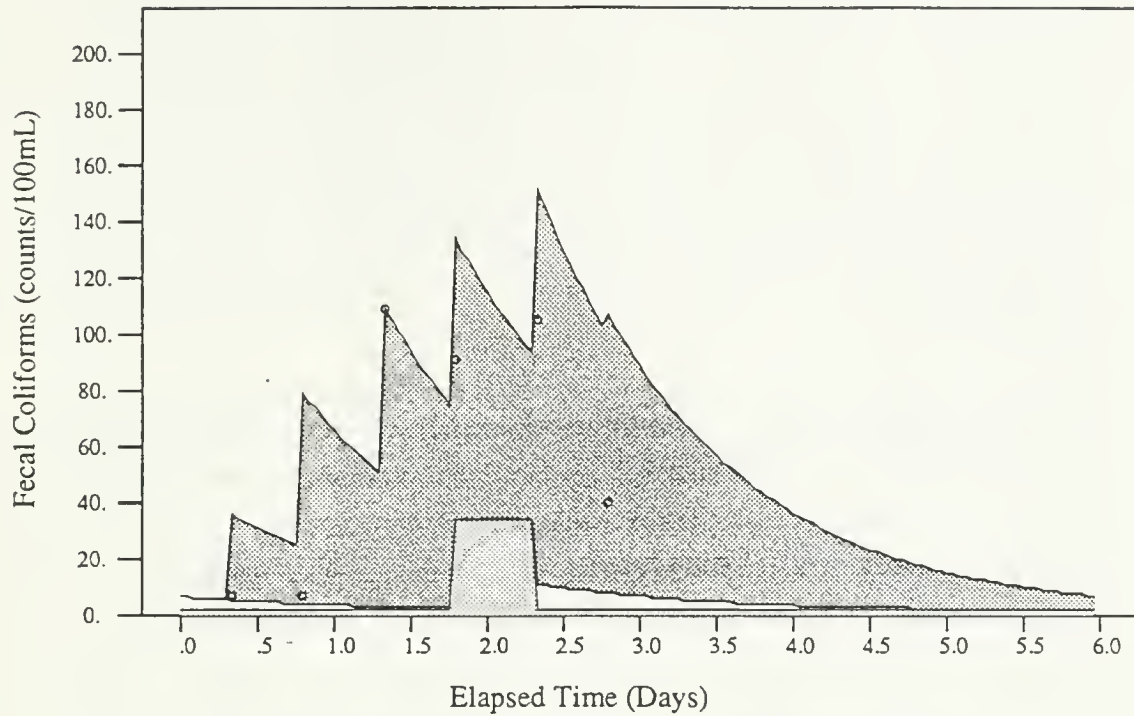
○ Observed Data

□ Background

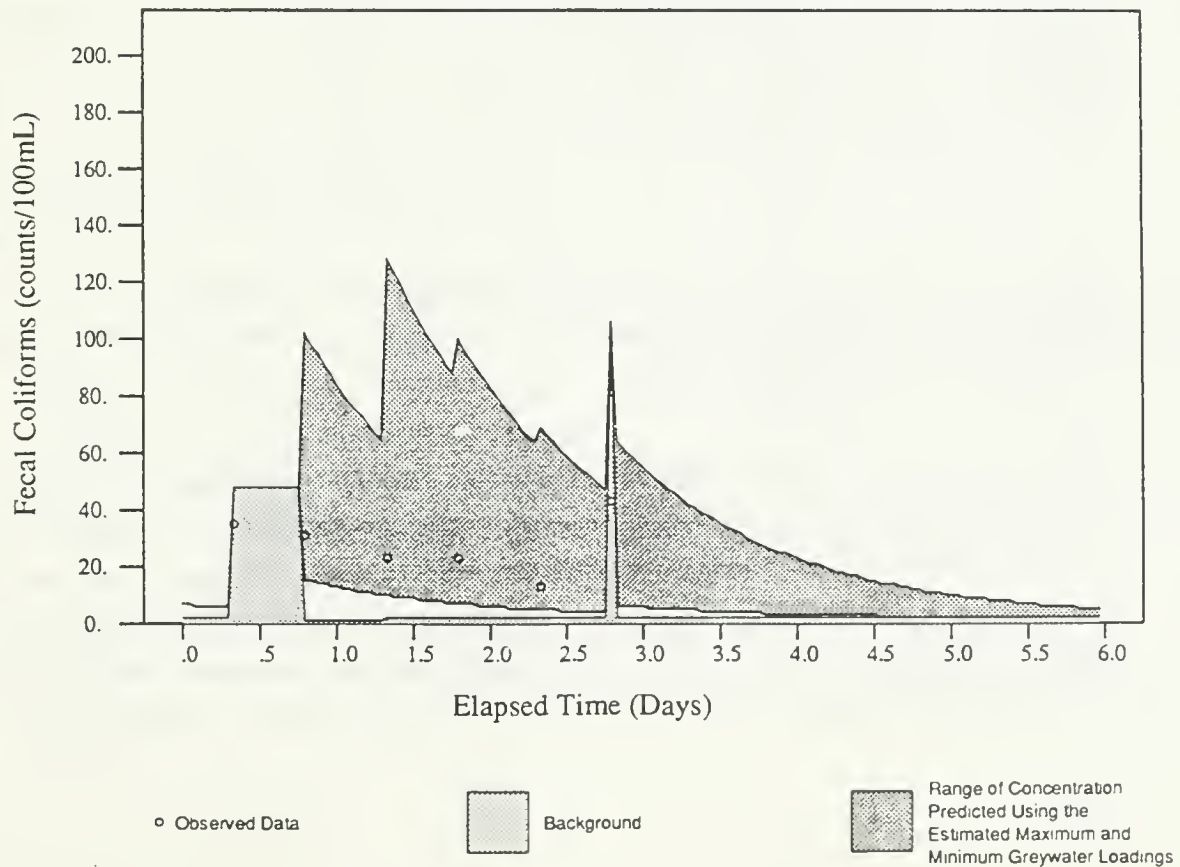
■ Range of Concentration  
Predicted Using the  
Estimated Maximum and  
Minimum Greywater Loadings

FIGURE 3-14

LOST BAY, AUGUST 1-3  
FECAL COLIFORMS



LOST BAY, AUGUST 8-10  
FECAL COLIFORMS



Results of this generic modelling are presented in Figure 3.13 for Frying Pan Bay and Figure 3.14 for Lost Bay. In each figure the observed fecal coliform densities are compared to the predicted range of coliform densities resulting from the observed boat densities. The periods of simulation in each case were extended to 6 days. Following the last sample collection on Monday evening all boats were assumed to leave the bays allowing natural exchange and bacterial die-off to reduce the densities towards background levels. This was done to examine the rate of recovery within the embayments.

These modelling results are not intended to suggest that these are the events that occurred on the days of sampling. Rather, they are presented to show the cause and effect relationship of embayment bacterial water quality to boat loadings under the assumptions used in the model. As discussed in section 3.2.1 the day to day variability in both the background and embayment fecal coliform densities prevents any statistically significant conclusions that boats affect embayment water quality. However, the results of the modelling clearly show the interactions between boat bacterial loadings, embayment exchange flow and embayment bacterial water quality. The interaction is barely noticeable using the minimum loading per boat (L min.) and quite noticeable when using the maximum loading per boat (L max.). For the combination of the observed numbers of boats and the value of L min. the total loadings to the embayments are not sufficient to bring the predicted embayment bacterial concentration much above background. Using the combination of the observed numbers of boats and the value of L max. the predicted embayment bacterial concentrations are sufficient to show a dynamic response above background levels. The sharply rising spikes in predicted concentration when using L max. are due to the assumption of pulse loads of bacteria associated with onboard activities each day at 08:00 hrs. and 18:00 hrs. The reduction in predicted concentrations following each spike is due to the combined effects of dilution by exchange flow and bacterial die-off.

The observed fecal coliform data for Frying Pan Bay and Lost Bay generally fall between the range of predicted embayment concentrations resulting from the observed numbers of boats and range of loadings per boat (Lmax, Lmin). In particular, the observed densities in Frying Pan Bay during both surveys and in Lost Bay during the first survey agree remarkably well in terms of trend over the three days of the survey with the predicted values using the assumed maximum loadings per boat per day (Lmax).



Based on this deterministic analysis of the interaction between embayment water quality and boat grey water loadings it is apparent that grey water discharges can adversely affect receiving water quality. The extent of the effect is highly site specific and depends on the number of boats, the volume of the embayment and the extent of the exchange flow between the embayment and surrounding waters. In the present study the effects of grey water discharge were most noticable in Frying Pan Bay during the first sampling on the August 1, 2, 3 holiday weekend because of the relatively small volume of the bay and the high boat useage. Blind channel in Pigeon Lake was not modelled because of the three embayments studied it has the largest volume, least boat density, greatest exchange potential with the surrounding waters, and would be predicted to show little effect. The survey data for Blind Channnel confirms this conclusion.

### 3.3 Quality Assurance and Quality Control

#### 3.3.1 General

In any field sampling and laboratory analysis project of the type described herein it is important to measure the reliability of the data by a coherent program of internal checks. In this study the quality assurance and quality control (QA/QC) program consisted of a series of triplicate samplings of the grey water and embayment waters to determine the replicability of the sampling process, and a laboratory program of random duplicate analyses, and taxonomic verification to ensure that the laboratory analysis method produced repeatable results and that appropriate organisms were identified.

#### 3.3.2 Triplicate Analysis

Approximately 54 of the grey water samples (24%) and 132 of the embayment samples (33%) were triplicated in the field. The results of the primary samples and the triplicate analyses were compared to identify if any biases existed in the field sampling procedure. The log (10) results for each set of triplicate data were plotted on a graph with the maximum triplicate result as the ordinate and the minimum triplicate as the absissa for each of the three organisms considered in the study (Figure 3.15 to 3.17).

In all three figures it is apparent that there are two distinct groupings of data displayed. The lower of these groups corresponds to the triplicates carried out on the

FIGURE 3-15

HI LO REPLICATE PLOT  
FECAL COLIFORMS

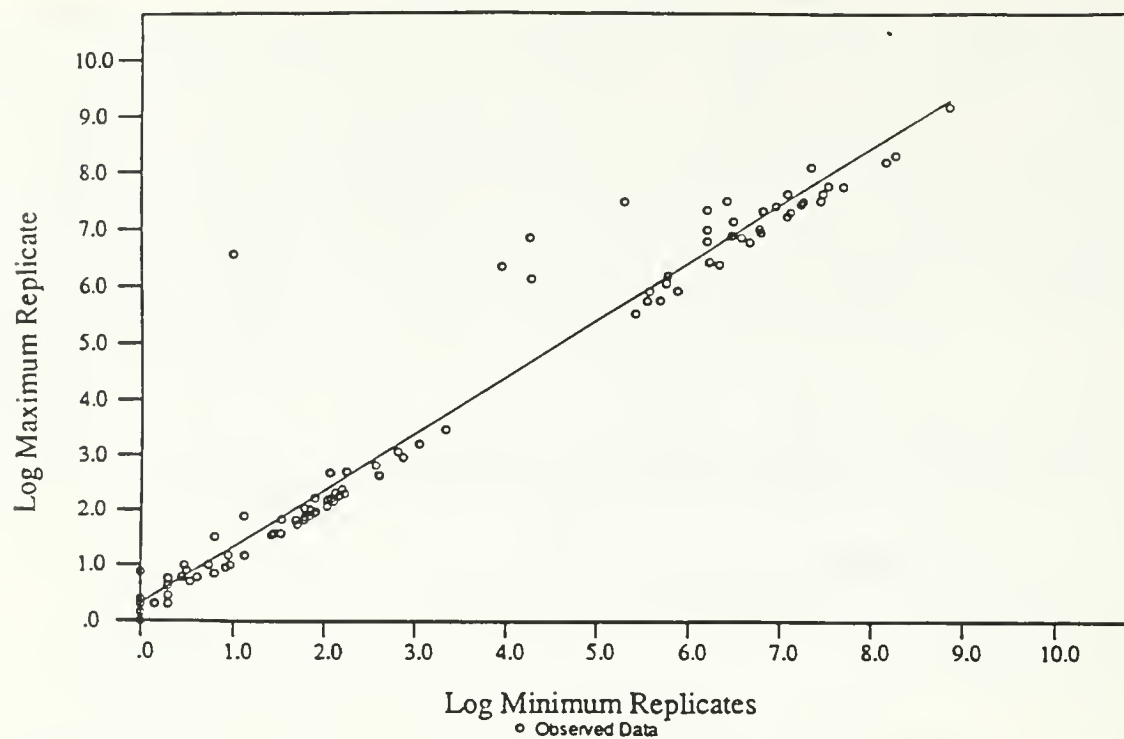


FIGURE 3-16

HI LO REPLICATE PLOT  
E. COLI

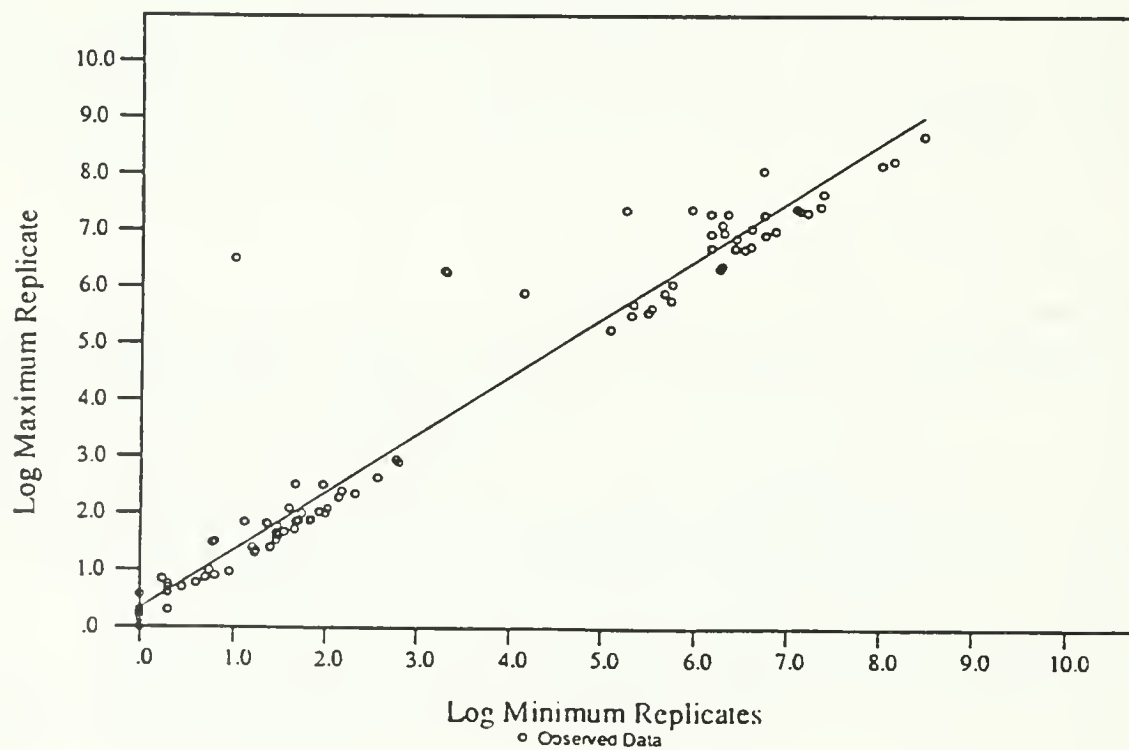
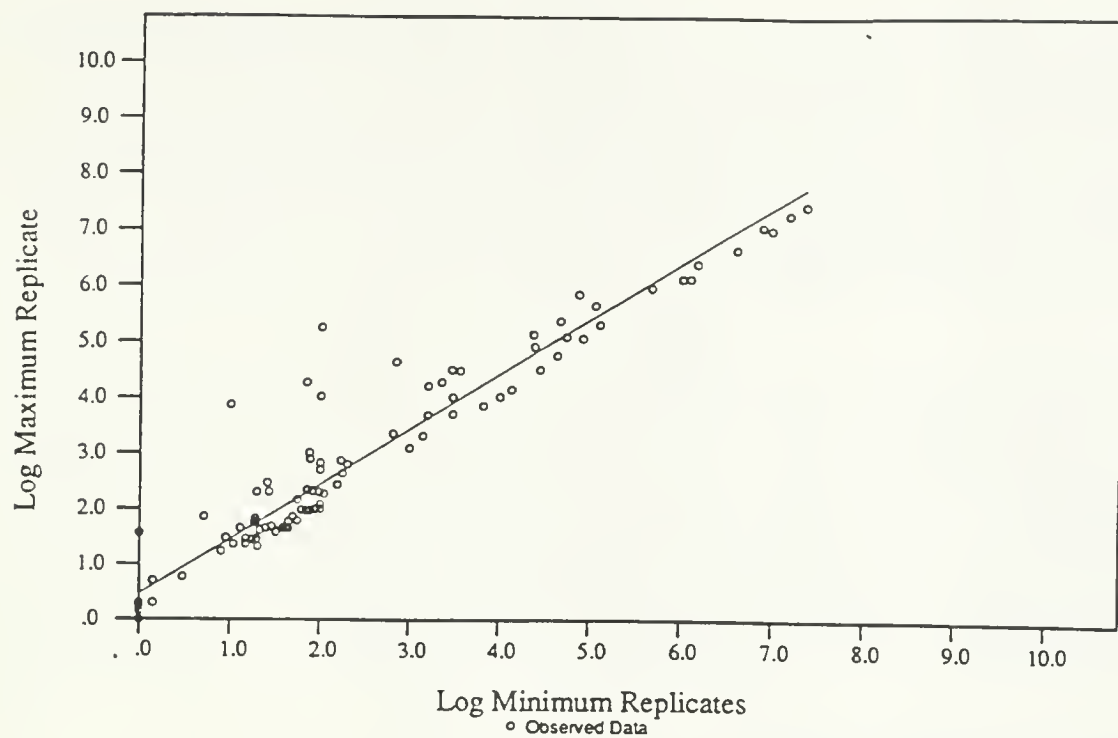




FIGURE 3-17

HI LO REPLICATE PLOT  
P. AERUGINOSA



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TABLE 3.9: SAMPLING AND ANALYSIS REPLICATE REGRESSION DATA

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Sampling Replicate Results

|                     | <u>Slope</u> | <u>Intercept</u> | <u>R<sup>2</sup></u> |
|---------------------|--------------|------------------|----------------------|
| Fecal Coliforms     | 1.01         | 0.311            | 0.94                 |
| <u>E. coli</u>      | 1.02         | 0.331            | 0.94                 |
| <u>P aeruginosa</u> | 0.987        | 0.463            | 0.92                 |

Analysis Replicate Results

|                     |      |       |      |
|---------------------|------|-------|------|
| Fecal Coliforms     | 1.00 | 0.145 | 0.99 |
| <u>E. coli</u>      | 1.01 | 0.113 | 0.99 |
| <u>P aeruginosa</u> | 0.99 | 0.153 | 0.98 |

---

embayment samples where densities were lower than those observed in the grey water samples. The grey water sample triplicates are represented in the higher group on the two figures. The lines fitted through each of the data sets shows excellent agreement with the data in both the high and low groups indicating consistency in both of the ranges. In the case of *P. aeruginosa*, the demarcation between the grey water samples and the embayment samples is less distinct. However, a good fit has been achieved for the line in this figure as well, indicating good agreement between triplicates.

For the graphs depicted in these figures, a perfect fit of the replicate data would result in a line intercepting the origin and with a slope of 1.0. Departures from this would indicate the presence of a bias in the analytical results. The slopes, intercepts and correlation coefficients for the three organisms are shown in Table 3.9. In each case, the slopes are sufficiently close to unity and the intercepts to zero to conclude there is no sampling bias. This analysis procedure was repeated for the internal laboratory quality control replicates. The results were similar and indicate that there was no analytical bias.

### 3.4 Taxonomy

#### 3.4.1 General

Several groups of intestinal micro-organisms have been used as indicators of fecal contamination including "fecal streptococci" and "coliform" bacteria. The coliform bacteria are the most commonly used indicator of fecal contamination. Coliforms is an operational and not a taxonomic definition and is defined as those organisms which are gram negative, non-sporeforming rods that ferment lactose to acid and gas at 35°C within 48 hours. This definition includes *E. coli*, *Citrobacter* and other related genera such as *Klebsiella* and *Enterobacter*. Fecal coliform has the same definition but can ferment lactose to acid and gas at 44.5°C and includes the same organisms. Of these, *E. coli* is the best indicator of fecal pollution since it is a common inhabitant of the gut and is rarely found outside the gut except if there has been contamination by human or animal excreta. *E. coli* also dies off in water at a slightly slower rate than typical pathogens (e.g., *Salmonella typhi*). These attributes of *E. coli* are in contrast to *K. pneumoniae* and *C. freundii* which are found in feces but are also commonly isolated from soils and sediments. *E. aerogenes* is a normal soil inhabitant.

Pseudomonas aeruginosa is a common soil inhabitant which is also an opportunistic pathogen and can grow at temperatures up to 43°C, whereas other non-pathogenic species of Pseudomonas cannot. It is often associated with swimmers ear, urinary and respiratory tract infections as well as systemic infection in patients that have received severe burns. Further, Pseudomonas aeruginosa, like other Pseudomonas, carry resistance to many antibiotics which makes treatment of infected patients difficult. This examination of waters for Pseudomonas aeruginosa is done for health and safety reasons.

There are many streptococci that exist in the digestive system such as Streptococcus faecalis which is present in the large intestine in significant numbers. Thus this organism can also be used as an indicator of fecal contamination of water. However, its die off rate is slower than E. coli and thus can persist in water after contamination. It is therefore best to use this indicator in conjunction with fecal coliform data to indicate the source and relative time of contamination of water by feces.

Microbiological analyses were carried out by filtering a water sample and then placing the filter on an appropriate selective/differential medium. The individual viable bacterium trapped on the surface of the filter grow into colonies of cells if they can utilize the nutrients provided. After sufficient time the colonies of cells that have arisen from the single cell become visible to the eye. By addition of certain nutrients and inhibitors, only those organisms that can utilize those nutrients and tolerate those inhibitors will grow, thus the media is termed selective. The addition of dye and indicators helps differentiate physiological groups of bacteria. Further, the incubation temperature and atmosphere composition can be used as additional selective mechanisms.

If the bacterium can grow on the medium supplied and under the environment provided it will form distinct colonies which will exhibit specific colony morphology and pigmentation. Similar colonies will theoretically be associated with a bacterial species or physiologically similar groups of organisms. The colonies can then be counted or picked, further purified and then identified by biochemical analyses. If a colony's characteristics match those of a previously identified bacteria's colony formation on that medium, it can be called a typical or positive (+) colony and counted as that organism (Appendix A).

### 3.4.2 Taxonomic Results

One target group of micro-organisms, the fecal coliforms (FC), and two target micro-organisms, Escherichia coli (EC) and Pseudomonas aeruginosa (PA) were used in this study to gauge the impact of grey water discharge on receiving waters. To determine if the positive fecal coliforms (+FC) were "true" fecal coliforms and that colonies identified as E. coli (+EC) and P. aeruginosa (+PA) were E. coli and P. aeruginosa, respectively, positive colonies were picked from the initial 6 on board samples from each fixture from each boat and identified. The "+" followed by two letters (e.g., EC for E. coli) indicates a colony that matches the typical colony characteristics of that organism, whereas, the "-" indicate a non-typical colony, i.e., it is a colony that does not match the typical colony characteristics of that organism on that media. The organism that was identified is presented under the appropriate heading in Appendix A.

### 3.4.3 Coliform Identification

Typical (+) fecal coliform colonies are yellow, yellow-brown or yellow-green on m-TEC media. To distinguish E. coli colonies from other fecal coliforms the filter was transferred from the m-TEC media to a urea broth. If the organism possesses the urease enzyme it liberates ammonia from urea and raises the pH. This change in pH is detected by a pH indicator in the urea broth. E. coli does not possess the urease enzyme and so there will be no colour change around the colony. Other fecal coliforms are typically urease positive, although there are Klebsiella sp. that are urease negative and Citrobacter often has delayed response.

Positive and negative fecal coliform and E. coli colonies were picked and further identified by a Enterobacteriaceae biochemical test strip. Of the 18 positive fecal coliform colonies, only 11 (61%) were identified as fecal coliforms. Of these only 1 was identified as E. coli and the remaining 10 as K. pneumoniae. The remaining 7 isolates were identified as the coliform organism Enterobacter. Fifty isolates were identified as E. coli based on a negative urease response but only 3 (6%) were positively identified using biochemical testing as E. coli. The remaining isolates were identified as Enterobacter sp. (58%), Citrobacter sp. (22%), Klebsiella (8%), and other non-coliforms (6%).

#### 3.4.4 *Pseudomonas aeruginosa*

Typical positive (+) *Pseudomonas aeruginosa* populations appear as tan to dark brown colonies on m-PA media after 48 hours at 41.5°C. Positive identification of *P. aeruginosa* involves transferring the positive colonies to skim milk agar and incubating at 35°C for 24-48 hours. *P. aeruginosa* will produce a blue-green pigment that diffuses into the surrounding medium and will fluoresce when exposed to UV light. There will be clearing around the colony due to caseinase activity.

The agreement between a typical (+) colony on m-PA and a positive identification as *P. aeruginosa* on skim milk agar was 100% with 48 of the 48 positive colonies identified as *P. aeruginosa*. This agreement did not hold for the colonies tested by a commercial biochemical testing strip. Of the three *P. aeruginosa* type colonies only one was identified as a *P. sp.* but not as *P. aeruginosa*. The two negative (non *P. aeruginosa* like) colonies were not identified as *P. aeruginosa*. However the test strips used are designed for the Enterobacteriaceae and commonly misidentify Pseudomonads.

#### 3.4.5 Summation of Taxonomic Results

The question arises as to the interpretation of the FC, EC and PA counts as indicators of fecal contamination. Identification of the bacterial isolates show few *E. coli*, of true fecal origin, versus many *Klebsiella pneumoniae*, which can be of fecal origin but are also commonly isolated from soils. If the quality of grey water is based solely on fecal coliform counts using the urease test, it could be concluded from the results of this study that these waters were contaminated with fecal matter. However, for those samples subjected to more detailed (selective) analysis, the more specific taxonomic identification of the urease negative fecal coliforms indicate that the majority of fecal coliforms could be derived from other non-fecal sources. It should be noted, however, that *P. aeruginosa* is an opportunistic pathogen and could pose a health risk regardless of origin.

Although all testing and identification of the colonies was conducted by standard procedures as outlined by the MOE, it is possible that the selection of isolates for identification may be marginally biased. This small bias could be introduced in the sampling of the isolated colonies from the membrane filter, i.e., the selection of colonies



for identification may not have been totally random. Hence, even though the number of isolates taken may be large, the averages given may be slightly skewed.

#### 3.4.6 Fecal Streptococcus Results

The results of the taxonomic analysis described above (Section 3.4.5) raises the significant question of whether or not the contamination of the grey water and subsequently of the embayments themselves is of fecal origin. From the taxonomic analysis it is clear that many of the organisms identified as fecal coliforms by the urease test do not confirm as being of fecal origin. This implies that many of the fecal coliform organisms may originate from non-fecal sources and thereby may not represent a true indication of the possibility of pathogenic organisms. To further study the possible presence of pathogenic organisms, the Fecal streptococcus results from the first three grey water samples from each boat and fixture were considered.

The MOE Blue Book ("Water Management, Policies Goals and Objectives of the Ministry of the Environment", May 1978) describes a rule of thumb whereby some indication of the origin of fecal pollution may be gained. If the ratio of fecal coliform to fecal streptococcus is greater than 4.0, it is considered an indication of pollution of human origin. If the ratio is less than 0.7, human origin cannot be assumed. Between these two rather wide values no conclusion can be drawn. However, more recent work by MOE has shown the use of this method is cautionary since the data are highly variable by nature and the relative ages of the samples can affect the relationship due to unequal die-off rates for the two organisms. Further, the number of Fecal streptococcus analyses is limited making extrapolation to the total of the grey water samples tenuous at best.

The results of the fecal coliform to fecal strep ratio should be viewed with further caution since it presumes that the fecal coliform are confirmed E. coli (i.e., of fecal origin). From the confirmatory test results reported previously, some doubt exists as to the robustness of the conclusion that the fecal coliform and E. coli densities observed are demonstrably fecal in origin. If a large proportion of the bacteria measured as fecal coliform and E. coli are not positively identified as such, then the results of the ratio analysis are invalid. The results nevertheless are offered for consideration.

TABLE 3.10:

FECAL STREPTOCOCCUS TO FECAL COLIFORM COMPARISON

| Sample Location         | Fecal Coliforms<br>(per 100 ml) | Log FC | Fecal Strep.<br>(per 100 ml) | Log FS | Fecal Strep./<br>Fecal Coli |
|-------------------------|---------------------------------|--------|------------------------------|--------|-----------------------------|
| <b>Headsink Data</b>    |                                 |        |                              |        |                             |
|                         | $6.1 \times 10^4$               | 4.79   | $5.0 \times 10^2$            | 2.70   | 122.0                       |
|                         | $1.8 \times 10^4$               | 4.26   | $2.3 \times 10^4$            | 3.36   | 7.9                         |
|                         | $2.0 \times 10^6$               | 6.30   | $1.6 \times 10^5$            | 4.20   | 125.0                       |
|                         | $3.8 \times 10^5$               | 5.58   | $1.3 \times 10^5$            | 5.11   | 2.9                         |
|                         | $1.0 \times 10^4$               | 4.00   | $3.0 \times 10^4$            | 4.48   | 0.3                         |
|                         | $1.2 \times 10^7$               | 7.08   | $1.2 \times 10^6$            | 6.09   | 9.8                         |
|                         | $3.8 \times 10^6$               | 6.58   | $1.0 \times 10^2$            | 2.00   | 38,000.0                    |
|                         | $1.0 \times 10^5$               | 5.00   | $9.5 \times 10^2$            | 2.98   | 105.3                       |
|                         | $1.1 \times 10^4$               | 4.04   | $4.2 \times 10^3$            | 3.62   | 2.6                         |
| Geometric Mean          | $2.0 \times 10^5$               |        | $6.9 \times 10^3$            | 28.4   |                             |
| <b>Shower Data</b>      |                                 |        |                              |        |                             |
|                         | $4.0 \times 10^5$               | 5.60   | $7.3 \times 10^4$            | 4.86   | 5.5                         |
|                         | $9.0 \times 10^3$               | 3.95   | $4.4 \times 10^4$            | 4.64   | 0.2                         |
|                         | $4.8 \times 10^7$               | 7.68   | $2.0 \times 10^6$            | 5.30   | 240.0                       |
|                         | $2.2 \times 10^6$               | 6.34   | $2.1 \times 10^6$            | 6.32   | 1.0                         |
|                         | $2.7 \times 10^7$               | 7.43   | $8.6 \times 10^4$            | 4.93   | 314.0                       |
|                         | $1.1 \times 10^5$               | 5.04   | $1.1 \times 10^4$            | 4.06   | 9.6                         |
|                         | $3.4 \times 10^5$               | 5.53   | $2.5 \times 10^4$            | 4.40   | 13.6                        |
|                         | $1.6 \times 10^5$               | 5.20   | $1.2 \times 10^4$            | 4.08   | 13.1                        |
|                         | $1.4 \times 10^6$               | 6.15   | $2.9 \times 10^6$            | 6.46   | 0.5                         |
| Geometric Mean          | $7.6 \times 10^5$               |        | $1.0 \times 10^5$            | 7.5    |                             |
| <b>Galley Sink Data</b> |                                 |        |                              |        |                             |
|                         | $1.5 \times 10^7$               | 7.18   | $1.0 \times 10^2$            | 2.00   | 150,000.0                   |
|                         | $4.0 \times 10^3$               | 3.60   | $1.0 \times 10^1$            | 1.00   | 400.0                       |
|                         | $2.1 \times 10^7$               | 7.32   | $1.0 \times 10^3$            | 3.00   | 21,000.0                    |
|                         | $5.0 \times 10^6$               | 6.70   | $6.6 \times 10^5$            | 5.82   | 7.6                         |
|                         | $1.6 \times 10^5$               | 5.20   | $1.8 \times 10^5$            | 5.25   | 0.9                         |
|                         | $6.0 \times 10^6$               | 6.78   | $4.3 \times 10^5$            | 5.63   | 14.0                        |
|                         | $1.0 \times 10^1$               | 1.00   | $5.0 \times 10^1$            | 1.70   | 0.2                         |
|                         | $1.0 \times 10^1$               | 1.00   | $2.1 \times 10^3$            | 3.32   | 0.0                         |
|                         | $1.8 \times 10^7$               | 7.25   | $1.0 \times 10^3$            | 3.00   | 18,000.0                    |
| Geometric Mean          | $1.3 \times 10^5$               |        | $2.6 \times 10^3$            | 50.2   |                             |

The ratios were calculated for each sample and for the geometric means of the two strains for each of the fixtures. No attempt was made to differentiate between boats (Table 3.10). All three of the fixture geometric means were also greater than 4.0.

### 3.5 Marina Pumpout Capacity Survey

An important part of this project was to determine the effect of any possible regulatory action regarding grey water holding upon the available pumpout facilities in the province. To fulfill this component of the project, a survey of the yacht clubs, marinas and community facilities in the major boating areas of the province was carried out. In Lake Ontario, Rideau River, Trent System, and Southern Georgian Bay, the majority of selected sites were visited in person. In the Lake of the Woods area a telephone survey was conducted. A total of 98 sites were contacted during the survey and a questionnaire completed on each site (Appendix B).

Pumpout locations were found to vary widely in their hours of operation and to some degree in their open season. In general they are open for 4 to 12 hours daily from May to October. Typically, each location has one pumpout hose available which discharges to a holding tank, directly to sewer or to a tile field. In the case of those locations discharging to a holding tank, periodic pumpouts of the holding tank are required. These typically vary from 1 to 8 per month. The number of boats serviced varied from 5 to 160 per week. In areas where large numbers of boats were serviced, multiple pumpout hoses were typically available.

The principal purpose of carrying out the pumpout survey was to determine the available capacity. The capacity of a single pumpout facility is a function of the pump capacity, the hours of operation, the size of the holding tank if applicable, the productivity of the attendants and the time required to manouver boats into and out of the facility. In addition, many pumpouts are situated adjacent to fueling facilities, and pumpout activity is usually carried out at the same time as refueling which increases the time each boat is tied to the dock.

The size of the holding tank to which the waste pump discharges is a restriction on the overall capacity of the facility only if it can be filled with a normal day's operation. In this case, the facility would be out of service regularly. This is not the case for most of

the facilities surveyed. Therefore, holding tank capacity is not a strong restriction since capacity is restored each time the haulage truck arrives and evacuates the tank. Additional pumpout demand would precipitate more haulage events. For those facilities which discharge directly to sewerage systems, there is effectively no limitation upon the volume of pumpout fluids which can be accommodated. Approximately 12% of the pumpout facilities contacted reported that they discharge to tile fields, but many also reported that waste was hauled. The capacity of a tile field is a true limitation on the volume of pumpout fluids which can be accommodated.

Based upon the above discussion, the capacity of the existing pumpout facilities in the province is more a function of the number of boats that can be serviced than the volume of wastes generated. Accordingly, the number of boats which can be accommodated at a given facility with one hose is estimated to be four per hour. Because of the demands upon attendants' time for refueling and other marina duties, a total of 6 hours per day of pumpout activity was assumed. These assumptions lead to an estimate of the available capacity in terms of boats. The number of boats currently being serviced represents the portion of total capacity in use. The difference represents the un-used capacity of the facilities. Using these assumptions, the available capacity in each of the regions was calculated for those facilities which were open to the public.

The results of the capacity calculations show that a large amount of the installed capacity is not utilized (Figure 3.18). Overall usage of pumpout facilities varied from 13% in the Lake of the Woods area to 34% in the southern Georgian Bay area. From this analysis it appears that significant additional capacity is available for grey water pumping.

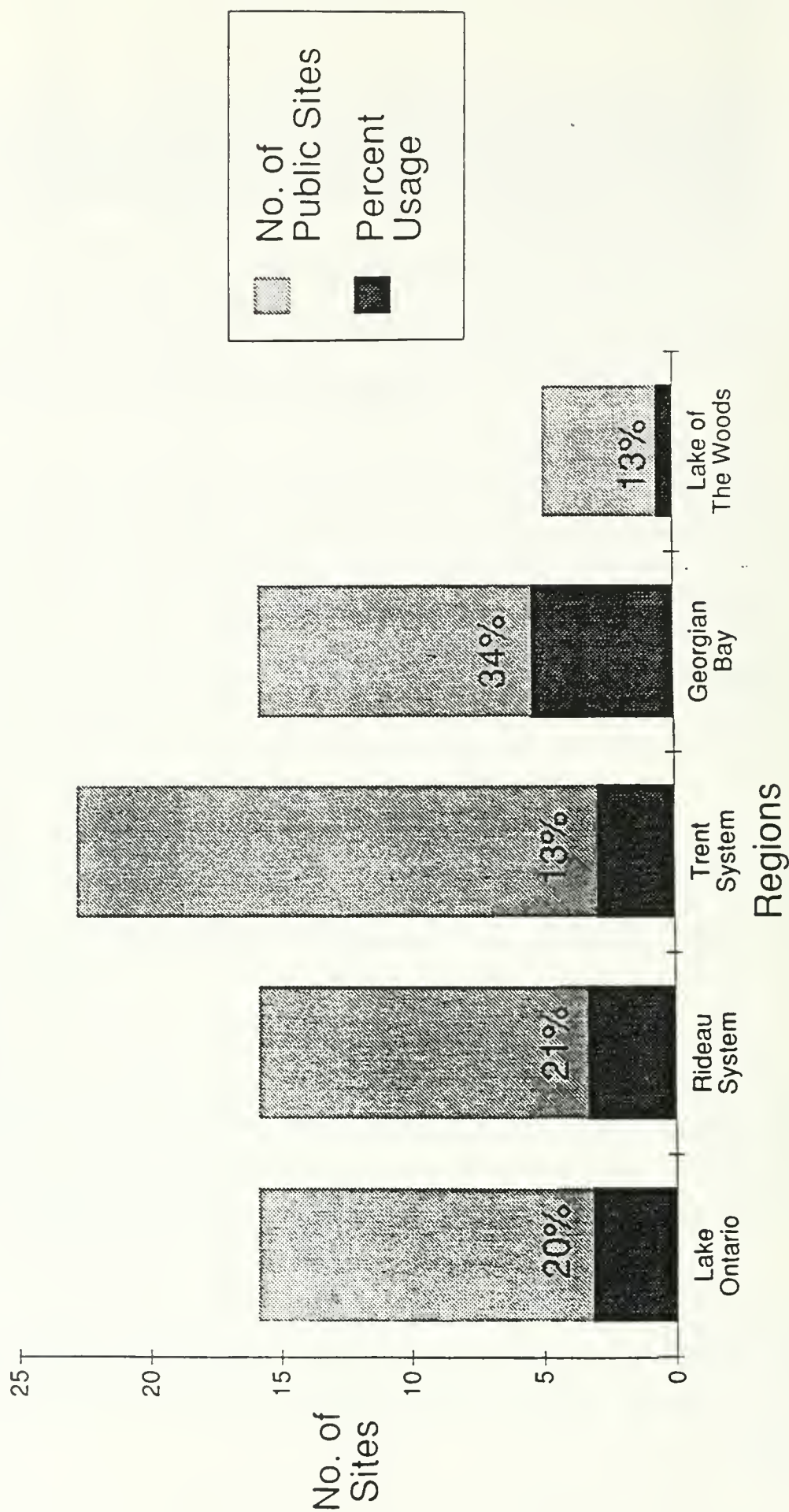
However, based on the measured and estimated rates of grey and black water production and assuming that grey water is contained in onboard tankage sized to provide the same number of days retention as the black water tank, then the pumpout utilization would increase by 250 to 300 percent over present levels. This would increase the existing utilization to 100 percent in the southern Georgian Bay area.

It should be noted that by design the study focussed on those areas in the province with the greatest pleasure boat densities and hence areas with the best coverage of pumpout facilities. Other areas frequented by pleasure boats are known to be poorly serviced or

virtually unserved (e.g., Northeast Shore of Georgian Bay, North Channel of Lake Huron and North Shore of Lake Superior). Restrictions on Grey Water discharge would severely limit recreational boating in such areas unless a suitable network of pumpout facilities were provided.



**FIGURE 3.18  
PUMPOUT STATIONS AVAILABLE  
TO THE PUBLIC**





## 4.0 SUMMARY

1. The data collected on the bacterial densities in the grey water samples from the pleasure boats and in the embayment samples was subjected to a quality control and quality assurance procedure which indicated that the results were not subject to any sampling or analytical bias. Accordingly, these results may be used in evaluating the bacterial quality of the grey water and the effects of the discharge of the grey water upon the embayment receiving waters chosen for study.
2. The Ministry of the Environment "Blue Book" containing objectives for recreational water use states that a potential health hazard exists:
  - o "if the fecal coliform geometric mean density for a series of samples exceeds 100 per 100 ml";
  - o "when pathogenic organisms (e.g., Pseudomonas aeruginosa ...) can be enumerated and frequently isolated from the water".
3. Based on the results of MOE standard presumptive test procedures, the grey water produced by the use of the galley sink, head sink and the shower exhibits high densities of fecal coliforms, E. coli and Pseudomonas aeruginosa. Densities were found to be in the range of  $10^4$  to  $10^8$  organisms/100 ml for fecal coliform and E. coli, and from  $10^2$  to  $10^6$  organisms/100 ml for Pseudomonas aeruginosa.
4. However, when a subset of the bacteria identified as E. coli using standard presumptive test procedures were subjected to confirmatory taxonomic analyses, only 6 percent of the subset so evaluated were confirmed as the species E. coli. Assuming the results of the confirmatory analyses are representative over the entire set of presumptive tests, only a small percentage of the fecal coliform containing samples identified using routine presumptive test procedures was actually of fecal origin. On the other hand, confirmatory taxonomic analyses on a similar subset of bacteria identified as positive using standard presumptive tests for Pseudomonas aeruginosa resulted in 100 percent confirmation of this species. Again, assuming the results of the confirmatory analyses are representative over the entire set of presumptive tests implies that the P. aeruginosa are actually present.

5. No single fixture could be identified as being consistently higher in bacterial density than any of the others. However, on many occasions, the galley sink densities were the highest. Similarly, no single type of boat was observed to exhibit higher densities than either of the other boat types studied. Crew lifestyle was found to be a significant factor in the overall variability of grey water quality.
6. An analysis of conventional pollutants (nutrients, solids, and oxygen demanding substances) revealed that grey water from all three fixtures exhibited high concentrations. However, because of relatively small volumes, the mass loadings of these substances were small.
7. The onboard fresh water use data suggest a range of consumption dependent on lifestyle and available potable water tankage. Water use was 16.6 and 21.7 litres per capita per day (l/c/d) for the sail and power boats, respectively. The observed water use in the house boat was 5.9 l/c/d. However, this latter value was thought to be significantly low, a more reasonable estimate being in the order of 21 l/c/d. Black water production was estimated to average 10 l/c/d.
8. Based on results of presumptive testing, fecal coliform concentrations in two of the studied embayments, Frying Pan Bay and Lost Bay, were observed to rise to levels in excess of the MOE Blue Book objectives for the recreational use of water during the summer weekends studied. Significant levels of P. aeruginosa were observed for all three embayments.
9. No statistically significant simple relationship between the number of boats in an embayment and the bacterial density of any of the three bacterial species (FC, EC, PA) could be found in the data collected in this survey. However, a deterministic model, simulating the inputs, exchange and natural die-off kinetics of fecal coliforms indicated that the observed fecal coliform densities in the embayments were consistent with those expected, given the range of grey water bacterial loadings possible from the boats present at the time of sampling.
10. The effects of grey water upon the bacterial quality of embayment waters is highly site specific. In small, heavily used bays, effects can be observed. In larger, less used or better flushed locations, effects cannot be observed.

11. There is presently excess pumpout capacity along the major recreational waterways of the province. Other waterways and recreational boating areas are poorly serviced (e.g., north east shore of Georgian Bay, Lake Huron North Channel, and north shore of Lake Superior). Grey water retention would increase the volume of pumpouts by 250 to 300 percent. This would bring existing pumpout utilization to nearly 100 percent of capacity in the Southern Georgian Bay area, which presently has the highest utilization of the areas surveyed.

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## 5.0 CONCLUSIONS

1. Data from the study indicate that few of the fecal coliforms and E. coli measured in the grey water are likely to actually be of fecal origin.
2. Pseudomonas aeruginosa was found in the grey water at both the presumptive and taxonomic levels of analysis, and was also found using presumptive test procedures in the receiving waters, both in the test embayments and control sites. It is a known opportunistic pathogen which is described in the MOE "Blue Book" as a potential health hazard if found in recreational waters.
3. Grey water from all three fixtures exhibited high concentrations of conventional pollutants (nutrients, solids, and oxygen-demanding substances). However, because of the relatively small volumes, the mass loadings of these substances was small.
4. Presumptive analysis of the grey water showed that the fecal coliform count exceeded, by several orders of magnitude, the MOE "Blue Book" objective for recreational water use of 100 fecal coliforms per 100 mL of water. Yet, as noted above, taxonomic analysis indicated that only a small percentage of the fecal coliforms in grey water was actually of fecal origin. However, because of the high concentrations reported, this would still indicate the potential for some fecal contamination of the receiving waters. These results would also indicate that the existing MOE fecal coliform standard may not be appropriate.
5. If it should be decided to require that pleasure boats retain grey water on board, it seems likely that, along the major recreational waterways, there would at present be adequate pump-out facilities to receive it. However, in areas with few pump-out facilities (e.g. north-east Georgian Bay, North Channel and Lake Superior), it would be necessary for new pump-out facilities to be established.





## APPENDIX A

BACTERIAL ANALYSIS DATA  
TAXONOMY DATA



## BACTERIAL ANALYSIS DATA



## Report of Bacterial Analysis

NOTE: (-2) means less than 2/100mls  
(1999) means greater than 1999/100mls  
Calculations are based only on 11 stations for embayment sampling

| Lab No. | Sample Station | DATE Rec'd mddy | Fecal Coliforms per 100mls | log-10 | E. coli per 100mls | LOG-10 | Pseudomonas aeruginosa per 100mls | LOG-10   |
|---------|----------------|-----------------|----------------------------|--------|--------------------|--------|-----------------------------------|----------|
| 7098    | BC-1-2         | 080287          | 24                         | 1.3802 | 11                 | 1.0414 | <                                 | 1 0.0000 |
| 7099    | BC-1-3         | 080287          | 1                          | 0.0000 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7100    | BC-1-4         | 080287          | <                          | 0.0000 | <                  | 0.0000 | <                                 | 1 0.0000 |
| 7101    | BC-1-5         | 080287          | <                          | 0.0000 | <                  | 0.0000 | <                                 | 1 0.0000 |
| 7102    | BC-1-6         | 080287          | 15                         | 1.1761 | 2                  | 0.3010 | <                                 | 1 0.0000 |
| 7103    | BC-1-7         | 080287          | 2                          | 0.3010 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7104    | BC-1-8         | 080287          | 3                          | 0.4771 | 2                  | 0.3010 | <                                 | 1 0.0000 |
| 7105    | BC-1-9         | 080287          | 30                         | 1.4771 | 20                 | 1.3010 | <                                 | 1 0.0000 |
| 7106    | BC-1-11        | 080287          | 2                          | 0.3010 | 2                  | 0.3010 | <                                 | 1 0.0000 |
|         |                |                 | MEAN                       | 0.6014 | MEAN               | 0.3681 | MEAN                              | 0.0000   |
|         |                |                 | VARIANCE                   | 0.3618 | VARIANCE           | 0.2363 | VARIANCE                          | 0.0000   |
| 7107    | BC-2-1         | 080287          | 69                         | 1.8388 | 2                  | 0.3010 | <                                 | 1 0.0000 |
| 7116    | BC-2-10        | 080287          | <                          | 0.0000 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7108    | BC-2-2         | 080287          | 4                          | 0.6021 | 3                  | 0.4771 | <                                 | 1 0.6021 |
| 7109    | BC-2-3         | 080287          | 1                          | 0.0000 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7110    | BC-2-4         | 080287          | 7                          | 0.8451 | 2                  | 0.3010 | <                                 | 1 0.0000 |
| 7111    | BC-2-5         | 080287          | 3                          | 0.4771 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7112    | BC-2-6         | 080287          | 110                        | 2.0414 | 110                | 2.0414 | <                                 | 1 0.0000 |
| 7113    | BC-2-7         | 080287          | 5                          | 0.6990 | 2                  | 0.3010 | <                                 | 1 0.0000 |
| 7114    | BC-2-8         | 080287          | 47                         | 1.6721 | 27                 | 1.4314 | <                                 | 1 0.0000 |
| 7115    | BC-2-9         | 080287          | 1                          | 0.0000 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7117    | BC-2-11        | 080287          | 80                         | 1.9031 | 1                  | 0.0000 | <                                 | 1 0.0000 |
|         |                |                 | MEAN                       | 0.9162 | MEAN               | 0.4612 | MEAN                              | 0.0547   |
|         |                |                 | VARIANCE                   | 0.5932 | VARIANCE           | 0.4159 | VARIANCE                          | 0.0300   |
| 7118    | BC-3-1         | 080287          | <                          | 0.0000 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7127    | BC-3-10        | 080287          | <                          | 0.0000 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7119    | BC-3-2         | 080287          | 40                         | 1.6021 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7120    | BC-3-3         | 080287          | 2                          | 0.3010 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7121    | BC-3-4         | 080287          | 2                          | 0.3010 | 1                  | 0.0000 | <                                 | 1 0.0000 |
| 7122    | BC-3-5         | 080287          | <                          | 0.0000 | 1                  | 0.0000 | <                                 | 1 0.0000 |





|      |          |          |          |        |          |     |        |          |        |
|------|----------|----------|----------|--------|----------|-----|--------|----------|--------|
| 7286 | BC-5-10  | BC-5-10  | 090367   | 2      | 0.3010   | -2  | 0.3010 | 1        | 0.0000 |
| 7278 | BC-5-2   | BC-5-2   | 090367   | 2      | 0.3010   |     | 0.3010 | 1        | 0.0000 |
| 7279 | BC-5-3   | BC-5-3   | 090367   | -2     | 0.3010   | -2  | 0.3010 | 1        | 0.0000 |
| 7280 | BC-5-4   | BC-5-4   | 090367   | 2      | 0.3010   | 2   | 0.3010 | 1        | 0.0000 |
| 7281 | BC-5-5   | BC-5-5   | 090367   | -2     | 0.3010   | -2  | 0.3010 | 1        | 0.0000 |
| 7282 | BC-5-6   | BC-5-6   | 090367   | -2     | 0.3010   | -2  | 0.3010 | 1        | 0.0000 |
| 7283 | BC-5-7   | BC-5-7   | 090367   | 10     | 1.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7284 | BC-5-8   | BC-5-8   | 090367   | 2      | 0.3010   | 2   | 0.3010 | 1        | 0.0000 |
| 7285 | BC-5-9   | BC-5-9   | 090367   | 2      | 0.3010   | 2   | 0.3010 | 1        | 0.0000 |
| 7287 | BC-5-11  | BC-5-11  | 090367   | 2      | 0.3010   | 2   | 0.3010 | 1        | 0.0000 |
| 7288 | BC-5-12  | BC-5-12  | 090367   | 2      | 0.3010   | 2   | 0.3010 | 1        | 0.0000 |
|      |          |          | MEAN     | 0.4281 | MEAN     |     | 0.3372 | MEAN     | 0.0000 |
|      |          |          | VARIANCE | 0.0727 | VARIANCE |     | 0.0513 | VARIANCE | 0.0000 |
| 7365 | BC-6-1   | BC-6-1   | 090487   | 2      | 0.3010   | 2   | 0.3010 | 1        | 0.0000 |
| 7394 | BC-6-10  | BC-6-10  | 090487   | 8      | 0.9031   | 7   | 0.8451 | 1        | 0.0000 |
| 7386 | BC-6-2   | BC-6-2   | 090487   | 8      | 0.9031   | 8   | 0.9031 | 1        | 0.0000 |
| 7387 | BC-6-3   | BC-6-3   | 090487   | 2      | 0.3010   | 1   | 0.0000 | 1        | 0.0000 |
| 7388 | BC-6-4   | BC-6-4   | 090487   | 3      | 0.4771   | 3   | 0.4771 | 1        | 0.0000 |
| 7389 | BC-6-5   | BC-6-5   | 090487   | 4      | 0.6021   | 3   | 0.4771 | 1        | 0.0000 |
| 7390 | BC-6-6   | BC-6-6   | 090487   | 9      | 0.9542   | 5   | 0.6990 | 1        | 0.0000 |
| 7391 | BC-6-7   | BC-6-7   | 090487   | 14     | 1.1461   | 3   | 0.4771 | 1        | 0.0000 |
| 7392 | BC-6-8   | BC-6-8   | 090487   | 26     | 1.4150   | 16  | 1.2041 | 1        | 0.0000 |
| 7393 | BC-6-9   | BC-6-9   | 090487   | 6      | 0.7782   | 5   | 0.6990 | 6        | 0.7782 |
| 7395 | BC-6-11  | BC-6-11  | 090487   | 36     | 1.5563   | 26  | 1.4150 | 1        | 0.0000 |
| 7396 | BC-6-12  | BC-6-12  | 090487   | 13     | 1.1139   | 13  | 1.1139 | 1        | 0.0000 |
|      |          |          | MEAN     | 0.8498 | MEAN     |     | 0.6816 | MEAN     | 0.0707 |
|      |          |          | VARIANCE | 0.1573 | VARIANCE |     | 0.1475 | VARIANCE | 0.0500 |
| 7505 | BC-7-1   | BC-7-1   | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7514 | BC-7-10  | BC-7-10  | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7506 | BC-7-2   | BC-7-2   | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7507 | BC-7-3   | BC-7-3   | 090987   | 3      | 0.4771   | 3   | 0.4771 | 1        | 0.0000 |
| 7508 | BC-7-4   | BC-7-4   | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7509 | BC-7-5   | BC-7-5   | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7510 | BC-7-6   | BC-7-6   | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7511 | BC-7-7   | BC-7-7   | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7512 | BC-7-8   | BC-7-8   | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7513 | BC-7-9   | BC-7-9   | 090987   | 1      | 0.0000   | 1   | 0.0000 | 1        | 0.0000 |
| 7515 | BC-7-11  | BC-7-11  | 090987   | -2     | 0.3010   | -2  | 0.3010 | 1        | 0.0000 |
| 7516 | BC-7-11R | BC-7-11R | 090987   | -10    | 1.0000   | -10 | 1.0000 | -5       | 0.6990 |
|      |          |          | MEAN     | 0.0707 | MEAN     |     | 0.0707 | MEAN     | 0.0000 |
|      |          |          | VARIANCE | 0.0239 | VARIANCE |     | 0.0239 | VARIANCE | 0.0000 |



[illegible]

| 7777 BC-12-11R  | BC-12 | 11R   | 081187 | 4                | 0.6021           | 2                | 0.3010           | -2               | 0.3010           |
|-----------------|-------|-------|--------|------------------|------------------|------------------|------------------|------------------|------------------|
|                 |       |       |        | MEAN<br>VARIANCE | 0.2570<br>0.0772 | MEAN<br>VARIANCE | 0.1777<br>0.0625 | MEAN<br>VARIANCE | 0.0274<br>0.0075 |
| 7129 FP8-1-1    | FP-1  | -1    | 080287 | 170              | 2.2304           | 1                | 0.0000           | 27               | 1.4314           |
| 7174 FP8-1-10   | FP-1  | -10   | 080287 | 25               | 1.3979           | 21               | 1.3222           | 41               | 1.6120           |
| 7134 FP8-1-2    | FP-1  | -2    | 080287 | 35               | 1.5441           | 27               | 1.4314           | 160              | 2.2041           |
| 7139 FP8-1-3    | FP-1  | -3    | 080287 | 14               | 1.2041           | 10               | 1.0000           | 10               | 1.0000           |
| 7144 FP8-1-4    | FP-1  | -4    | 080287 | 76               | 1.8808           | 6                | 0.7782           | 05               | 1.9294           |
| 7149 FP8-1-5    | FP-1  | -5    | 080287 | 120              | 2.0792           | 100              | 2.0000           | 89               | 1.9494           |
| 7154 FP8-1-6    | FP-1  | -6    | 080287 | 113              | 2.0531           | 56               | 1.7482           | 137              | 2.1347           |
| 7159 FP8-1-7    | FP-1  | -7    | 080287 | 47               | 1.6721           | 37               | 1.5682           | 34               | 1.5315           |
| 7164 FP8-1-8    | FP-1  | -8    | 080287 | 32               | 1.5051           | 14               | 1.1461           | 75               | 1.8751           |
| 7169 FP8-1-9    | FP-1  | -9    | 080287 | 30               | 1.4771           | 23               | 1.3617           | 49               | 1.6902           |
| 7179 FP8-1-11   | FP-1  | -11   | 080287 | 4                | 0.6021           | 1                | 0.0000           | 9                | 0.9542           |
|                 |       |       |        | MEAN<br>VARIANCE | 1.6042<br>0.1943 | MEAN<br>VARIANCE | 1.1233<br>0.3824 | MEAN<br>VARIANCE | 1.6850<br>0.1574 |
| 7130 FP8-2-1    | FP-2  | -1    | 080287 | 178              | 2.2504           | 68               | 1.8325           | 29               | 1.4624           |
| 7175 FP8-2-10   | FP-2  | -10   | 080287 | 72               | 1.8573           | 39               | 1.5911           | 15               | 1.1761           |
| 7135 FP8-2-2    | FP-2  | -2    | 080287 | 55               | 1.7404           | 45               | 1.6532           | 54               | 1.7324           |
| 7140 FP8-2-3    | FP-2  | -3    | 080287 | 170              | 2.2304           | 66               | 1.8195           | 46               | 1.6628           |
| 7145 FP8-2-4    | FP-2  | -4    | 080287 | 170              | 2.2304           | 150              | 2.1761           | 85               | 1.9294           |
| 7150 FP8-2-5    | FP-2  | -5    | 080287 | 124              | 2.0734           | 95               | 1.9777           | 38               | 1.5798           |
| 7155 FP8-2-6    | FP-2  | -6    | 080287 | 63               | 1.7993           | 38               | 1.5798           | 16               | 1.2041           |
| 7160 FP8-2-7    | FP-2  | -7    | 080287 | 1500             | 3.1761           | 300              | 2.4771           | 97               | 1.9848           |
| 7165 FP8-2-8    | FP-2  | -8    | 080287 | 300              | 2.4771           | 160              | 2.1461           | 31               | 1.4914           |
| 7170 FP8-2-9    | FP-2  | -9    | 080287 | 160              | 2.2553           | 70               | 1.8451           | 25               | 1.3979           |
| 7180 FP8-2-11   | FP-2  | -11   | 080287 | 1                | 0.0000           | 1                | 0.0000           | 48               | 1.6812           |
|                 |       |       |        | MEAN<br>VARIANCE | 2.0100<br>0.5437 | MEAN<br>VARIANCE | 1.7362<br>0.3694 | MEAN<br>VARIANCE | 1.5731<br>0.0624 |
| 7131 FP8-3-1    | FP-3  | -1    | 080287 | 480              | 2.6812           | 320              | 2.5051           | 81               | 1.9085           |
| 7176 FP8-3-10   | FP-3  | -10   | 080287 | 170              | 2.2304           | 100              | 2.0000           | 62               | 1.7924           |
| 7136 FP8-3-2    | FP-3  | -2    | 080287 | 2200             | 3.3424           | -100             | 2.0000           | 45               | 1.6532           |
| 7141 FP8-3-3    | FP-3  | -3    | 080287 | 460              | 2.6628           | 320              | 2.5051           | 38               | 1.5798           |
| 7146 FP8-3-4    | FP-3  | -4    | 080287 | 106              | 2.0253           | 73               | 1.8633           | 1590             | 3.2014           |
| 7151 FP8-3-5    | FP-3  | -5    | 080287 | 1500             | 3.1761           | 150              | 2.1761           | 178              | 2.2504           |
| 7156 FP8-3-6    | FP-3  | -6    | 080287 | 114              | 2.0569           | 67               | 1.8261           | 100              | 2.0000           |
| 7161 FP8-3-7    | FP-3  | -7    | 080287 | 200              | 2.3010           | 100              | 2.0000           | 58               | 1.7634           |
| 7166 FP8-3-8    | FP-3  | -8    | 080287 | 92               | 1.9638           | 42               | 1.6232           | 59               | 1.7709           |
| 7171 FP8-3-9    | FP-3  | -9    | 080287 | 170              | 2.2304           | 70               | 1.8451           | 39               | 1.5911           |
| 7181 FP8-3-11   | FP-3  | -11   | 080287 | 2                | 0.3010           | 1                | 0.0000           | 41               | 1.6128           |
| 7177 FP8-3-100C | FP-3  | -100C | 080287 | 132              | 2.1206           | 62               | 1.7924           | 39               | 1.5911           |

|      |            |      |       |          |        |          |        |          |        |        |
|------|------------|------|-------|----------|--------|----------|--------|----------|--------|--------|
| 7178 | FP8-3-100C | FP-3 | -100C | 090287   | 140    | 2.2041   | 69     | 1.6902   | 80     | 1.9031 |
| 7183 | FP8-3-110C | FP-3 | -110C | 090287   | 1      | 0.0000   | 1      | 0.0000   | 11     | 1.0414 |
| 7182 | FP8-3-110C | FP-3 | -110C | 090287   | 1      | 0.0000   | 1      | 0.0000   | 42     | 1.6232 |
| 7133 | FP8-3-10C  | FP-3 | -10C  | 090287   | 110    | 2.0414   | 50     | 1.6930   | 82     | 1.9139 |
| 7132 | FP8-3-10C  | FP-3 | -10C  | 090287   | 290    | 2.4624   | 180    | 2.2553   | 530    | 2.7243 |
| 7137 | FP8-3-20C  | FP-3 | -20C  | 090287   | 2700   | 3.4624   | -100   | 2.0000   | 53     | 1.7243 |
| 7138 | FP8-3-20C  | FP-3 | -20C  | 090287   | 2600   | 3.4150   | -100   | 2.0000   | 38     | 1.5798 |
| 7142 | FP8-3-30C  | FP-3 | -30C  | 090287   | 140    | 2.1461   | 68     | 1.8325   | 23     | 1.3617 |
| 7143 | FP8-3-30C  | FP-3 | -30C  | 090287   | 100    | 2.0000   | 33     | 1.5185   | 46     | 1.6628 |
| 7147 | FP8-3-40C  | FP-3 | -40C  | 090287   | 81     | 1.9085   | 67     | 1.8261   | 4500   | 3.6532 |
| 7148 | FP8-3-40C  | FP-3 | -40C  | 090287   | 47     | 1.6721   | 34     | 1.5315   | 5000   | 3.6970 |
| 7152 | FP8-3-50C  | FP-3 | -50C  | 090287   | 1140   | 3.0549   | 200    | 2.3010   | 150    | 2.1761 |
| 7153 | FP8-3-50C  | FP-3 | -50C  | 090287   | 1140   | 3.0549   | 300    | 2.4771   | 1243   | 3.0945 |
| 7157 | FP8-3-60C  | FP-3 | -60C  | 090287   | 113    | 2.0531   | 66     | 1.8042   | 50     | 1.7634 |
| 7158 | FP8-3-60C  | FP-3 | -60C  | 090287   | 104    | 2.0170   | 85     | 1.9294   | 138    | 2.1399 |
| 7162 | FP8-3-70C  | FP-3 | -70C  | 090287   | -100   | 2.0000   | -100   | 2.0000   | 24     | 1.3802 |
| 7163 | FP8-3-70C  | FP-3 | -70C  | 090287   | 180    | 2.2553   | 100    | 2.0000   | 16     | 1.2041 |
| 7167 | FP8-3-80C  | FP-3 | -80C  | 090287   | 72     | 1.8523   | 25     | 1.3979   | 29     | 1.4624 |
| 7168 | FP8-3-80C  | FP-3 | -80C  | 090287   | 95     | 1.9777   | 35     | 1.5441   | 69     | 1.8388 |
| 7173 | FP8-3-90C  | FP-3 | -90C  | 090287   | 160    | 2.2041   | 60     | 1.7782   | 27     | 1.4314 |
| 7172 | FP8-3-90C  | FP-3 | -90C  | 090287   | 230    | 2.3617   | 100    | 2.0000   | 77     | 1.8865 |
|      |            |      |       | MEAN     | 2.2701 | MEAN     | 1.8495 | MEAN     | 1.9203 |        |
|      |            |      |       | VARIANCE | 0.5795 | VARIANCE | 0.4097 | VARIANCE | 0.2009 |        |
| 7324 | FP8-4-1    | FP-4 | -1    | 090387   | 240    | 2.4150   | 120    | 2.0772   | 32     | 1.5051 |
| 7333 | FP8-4-10   | FP-4 | -10   | 090387   | 156    | 2.1931   | 36     | 1.5563   | 14     | 1.1461 |
| 7325 | FP8-4-2    | FP-4 | -2    | 090387   | 120    | 2.0772   | 20     | 1.3010   | 8      | 0.9031 |
| 7326 | FP8-4-3    | FP-4 | -3    | 090387   | 180    | 2.2553   | 80     | 1.9031   | 12     | 1.0772 |
| 7327 | FP8-4-4    | FP-4 | -4    | 090387   | 880    | 2.9445   | 210    | 2.3222   | 78     | 1.8921 |
| 7328 | FP8-4-5    | FP-4 | -5    | 090387   | 160    | 2.2041   | 40     | 1.6021   | 73     | 1.8633 |
| 7329 | FP8-4-6    | FP-4 | -6    | 090387   | 160    | 2.2041   | 40     | 1.6021   | 18     | 1.2553 |
| 7330 | FP8-4-7    | FP-4 | -7    | 090387   | 130    | 2.1139   | 30     | 1.4771   | 11     | 1.0414 |
| 7331 | FP8-4-8    | FP-4 | -8    | 090387   | 176    | 2.2455   | 44     | 1.6435   | 8      | 0.9031 |
| 7332 | FP8-4-9    | FP-4 | -9    | 090387   | 130    | 2.1139   | 10     | 1.0000   | 34     | 1.5315 |
| 7334 | FP8-4-11   | FP-4 | -11   | 090387   | 28     | 1.4472   | 28     | 1.4472   | 44     | 1.6435 |
|      |            |      |       | MEAN     | 2.2749 | MEAN     | 1.6487 | MEAN     | 1.3120 |        |
|      |            |      |       | VARIANCE | 0.0576 | VARIANCE | 0.1288 | VARIANCE | 0.1219 |        |
| 7313 | FP8-5-1    | FP-5 | -1    | 090387   | 440    | 2.6435   | 120    | 2.0772   | 16     | 1.2041 |
| 7322 | FP8-5-10   | FP-5 | -10   | 090387   | 250    | 2.3779   | 160    | 2.2041   | 14     | 1.1461 |
| 7314 | FP8-5-2    | FP-5 | -2    | 090387   | 210    | 2.3222   | 150    | 2.1761   | 15     | 1.1761 |
| 7315 | FP8-5-3    | FP-5 | -3    | 090387   | 580    | 2.7634   | 190    | 2.2788   | 18     | 1.2553 |
| 7316 | FP8-5-4    | FP-5 | -4    | 090387   | 240    | 2.3802   | 80     | 1.9031   | 31     | 1.4914 |
| 7317 | FP8-5-5    | FP-5 | -5    | 090387   | 120    | 2.0772   | 30     | 1.4771   | 15     | 1.1761 |
| 7318 | FP8-5-6    | FP-5 | -6    | 090387   | 114    | 2.0569   | 60     | 1.7782   | 12     | 1.0772 |
| 7319 | FP8-5-7    | FP-5 | -7    | 090387   | 230    | 2.3617   | 70     | 1.8451   | 20     | 1.3010 |

|      |          |          |          |      |        |      |        |      |        |
|------|----------|----------|----------|------|--------|------|--------|------|--------|
| 7320 | FPB-5-8  | FP-5 -8  | 080387   | 120  | 2.0792 | 20   | 1.3010 | 6    | 0.7782 |
| 7321 | FPB-5-9  | FP-5 -9  | 080387   | 100  | 2.0000 | 30   | 1.4771 | 24   | 1.3802 |
| 7323 | FPB-5-11 | FP-5 -11 | 080387   | -10  | 1.0000 | -10  | 1.0000 | -2   | 0.3010 |
|      |          |          | MEAN     |      | 2.1895 |      | 1.7765 |      | 1.1172 |
|      |          |          | VARIANCE |      | 0.1959 |      | 0.1559 |      | 0.0964 |
| 7362 | FPB-6-1  | FP-6 -1  | 080487   | 300  | 2.4771 | 190  | 2.2788 | 16   | 1.2041 |
| 7371 | FPB-6-10 | FP-6 -10 | 080487   | 310  | 2.4914 | 200  | 2.3010 | 4    | 0.6021 |
| 7363 | FPB-6-2  | FP-6 -2  | 080487   | 280  | 2.4472 | 170  | 2.2304 | 6    | 0.7782 |
| 7364 | FPB-6-3  | FP-6 -3  | 080487   | 8400 | 3.9345 | 8300 | 3.9191 | 290  | 2.4624 |
| 7365 | FPB-6-4  | FP-6 -4  | 080487   | 200  | 2.3010 | 130  | 2.1139 | 5    | 0.6970 |
| 7366 | FPB-6-5  | FP-6 -5  | 080487   | 260  | 2.4150 | 110  | 2.0414 | 19   | 1.2788 |
| 7367 | FPB-6-6  | FP-6 -6  | 080487   | 130  | 2.1139 | 70   | 1.8451 | 4    | 0.6021 |
| 7368 | FPB-6-7  | FP-6 -7  | 080487   | 280  | 2.4472 | 140  | 2.1461 | 5    | 0.6990 |
| 7369 | FPB-6-8  | FP-6 -8  | 080487   | 380  | 2.5798 | 120  | 2.0792 | 3    | 0.4771 |
| 7370 | FPB-6-9  | FP-6 -9  | 080487   | 230  | 2.3617 | 140  | 2.1461 | 6    | 0.7782 |
| 7372 | FPB-6-11 | FP-6 -11 | 080487   | 20   | 1.3010 | 20   | 1.3010 | 1    | 0.0000 |
|      |          |          | MEAN     |      | 2.4427 |      | 2.2184 |      | 0.8710 |
|      |          |          | VARIANCE |      | 0.3352 |      | 0.3596 |      | 0.3586 |
| 7482 | FPB-7-1  | FP-7 -1  | 080887   | 32   | 1.5051 | 29   | 1.4624 | 2    | 0.3010 |
| 7491 | FPB-7-10 | FP-7 -10 | 080887   | 47   | 1.6721 | 26   | 1.4150 | 1    | 0.0000 |
| 7483 | FPB-7-2  | FP-7 -2  | 080887   | 28   | 1.4472 | 21   | 1.3222 | 1    | 0.0000 |
| 7484 | FPB-7-3  | FP-7 -3  | 080887   | 56   | 1.7482 | 25   | 1.3979 | 1    | 0.0000 |
| 7485 | FPB-7-4  | FP-7 -4  | 080887   | 75   | 1.8751 | 58   | 1.7634 | 1    | 0.0000 |
| 7486 | FPB-7-5  | FP-7 -5  | 080887   | 76   | 1.8808 | 51   | 1.7076 | 1    | 0.0000 |
| 7487 | FPB-7-6  | FP-7 -6  | 080887   | 59   | 1.7709 | 16   | 1.2041 | 1    | 0.0000 |
| 7488 | FPB-7-7  | FP-7 -7  | 080887   | 64   | 1.8062 | 37   | 1.5482 | 1    | 0.0000 |
| 7489 | FPB-7-8  | FP-7 -8  | 080887   | 43   | 1.6335 | 38   | 1.5798 | 1    | 0.0000 |
| 7490 | FPB-7-9  | FP-7 -9  | 080887   | 46   | 1.6628 | 17   | 1.2304 | 1    | 0.0000 |
| 7492 | FPB-7-11 | FP-7 -11 | 080887   | 7    | 0.8451 | 6    | 0.7782 | 1    | 0.0000 |
|      |          |          | MEAN     |      | 1.6224 |      | 1.4027 |      | 0.0274 |
|      |          |          | VARIANCE |      | 0.0777 |      | 0.0683 |      | 0.0075 |
| 7579 | FPB-8-1  | FP-8 -1  | 080987   | 99   | 1.9956 | 16   | 1.2041 | 1800 | 3.2553 |
| 7588 | FPB-8-10 | FP-8 -10 | 080987   | 59   | 1.7709 | 20   | 1.3010 | 300  | 2.4771 |
| 7580 | FPB-8-2  | FP-8 -2  | 080987   | 145  | 2.1614 | 46   | 1.6628 | 440  | 2.6435 |
| 7581 | FPB-8-3  | FP-8 -3  | 080987   | 180  | 2.2553 | 44   | 1.6435 | 530  | 2.7243 |
| 7582 | FPB-8-4  | FP-8 -4  | 080987   | 60   | 1.7782 | 28   | 1.4472 | 1200 | 3.0772 |
| 7583 | FPB-8-5  | FP-8 -5  | 080987   | 121  | 2.0828 | 57   | 1.7559 | 300  | 2.4771 |
| 7584 | FPB-8-6  | FP-8 -6  | 080987   | 88   | 1.9445 | 18   | 1.2553 | 400  | 2.6021 |
| 7585 | FPB-8-7  | FP-8 -7  | 080987   | 67   | 1.8261 | 14   | 1.1461 | 300  | 2.4771 |
| 7586 | FPB-8-8  | FP-8 -8  | 080987   | 115  | 2.0607 | 22   | 1.3424 | 500  | 2.6990 |
| 7587 | FPB-8-9  | FP-8 -9  | 080987   | 48   | 1.6812 | 22   | 1.3424 | 400  | 2.6021 |



7599 FPB-8-11 FP-8 -11 080987

MEAN 1.2768 3 0.4771 400 2.6021  
VARIANCE 1.8941 1.3253 2.6944  
0.0668 0.1080 0.0576

7590 FPB-9-1 FP-9 -1 080987 78 1.8921 30 1.4771 200 2.3010  
7617 FPB-9-10 FP-9 -10 080987 80 1.9031 40 1.6021 26 1.4150  
7593 FPB-9-2 FP-9 -2 080987 34 1.5315 29 1.4624 28 1.4472 28 1.4624  
7596 FPB-9-3 FP-9 -3 080987 105 2.0212 6 0.7782 29 1.4624 29 1.4624  
7599 FPB-9-4 FP-9 -4 080987 61 1.7853 40 1.6021 25 1.3979 25 1.3979  
7602 FPB-9-5 FP-9 -5 080987 230 2.3617 190 2.2788 50 1.6990 50 1.6990  
7605 FPB-9-6 FP-9 -6 080987 51 1.7076 27 1.4624 71 1.8513 71 1.8513  
7608 FPB-9-7 FP-9 -7 080987 760 2.8608 640 2.8062 23 1.3617 23 1.3617  
7611 FPB-9-8 FP-9 -8 080987 140 2.1461 23 1.3617 27 1.4314 27 1.4314  
7614 FPB-9-9 FP-9 -9 080987 77 1.8865 77 1.8865 29 1.4624 29 1.4624  
7620 FPB-9-11 FP-9 -11 080987 6 0.7782 4 0.6021 220 2.3624 220 2.3624  
7616 FPB-9-90C FP-9 -90C 080987 69 1.8388 69 1.8388 37 1.5682 37 1.5682  
7615 FPB-9-90C FP-9 -90C 080987 71 1.8513 71 1.8513 63 1.7993 63 1.7993  
7618 FPB-9-100C FP-9 -100C 080987 50 1.6990 40 1.6021 34 1.5315 34 1.5315  
7619 FPB-9-100C FP-9 -100C 080987 520 2.7160 370 2.5682 2500 3.3979 2500 3.3979  
7621 FPB-9-110C FP-9 -110C 080987 2 0.3010 2 0.3010 26 1.4150 26 1.4150  
7622 FPB-9-110C FP-9 -110C 080987 4 0.6021 2 0.3010 200 2.3010 200 2.3010  
7624 FPB-9-110C FP-9 -110C 080987 6 0.7782 2 0.3010 208 2.3181 208 2.3181  
7623 FPB-9-110C FP-9 -110C 080987 4 0.6021 2 0.3010 26 1.4150 26 1.4150  
7592 FPB-9-10C FP-9 -10C 080987 85 1.9294 54 1.7324 23 1.3617 23 1.3617  
7591 FPB-9-10C FP-9 -10C 080987 89 1.9445 34 1.5315 32 1.5051 32 1.5051  
7595 FPB-9-20C FP-9 -20C 080987 64 1.8062 60 1.7782 21 1.3222 21 1.3222  
7594 FPB-9-20C FP-9 -20C 080987 69 1.8388 34 1.5315 15 1.761 15 1.761  
7598 FPB-9-30C FP-9 -30C 080987 81 1.9085 42 1.6232 25 1.3979 25 1.3979  
7597 FPB-9-30C FP-9 -30C 080987 51 1.7076 27 1.4314 79 1.8976 79 1.8976  
7600 FPB-9-40C FP-9 -40C 080987 83 1.9191 35 1.5441 26 1.4150 26 1.4150  
7601 FPB-9-40C FP-9 -40C 080987 160 2.2041 140 2.1461 70 1.8451 70 1.8451  
7604 FPB-9-50C FP-9 -50C 080987 160 2.2041 140 2.1461 74 1.8692 74 1.8692  
7603 FPB-9-50C FP-9 -50C 080987 52 1.7160 39 1.5911 1 0.0000 1 0.0000  
7607 FPB-9-60C FP-9 -60C 080987 56 1.7482 29 1.4624 26 1.4150 26 1.4150  
7606 FPB-9-60C FP-9 -60C 080987 830 2.9191 730 2.8633 10 1.0000 10 1.0000  
7609 FPB-9-70C FP-9 -70C 080987 890 2.9494 860 2.9345 12 1.0792 12 1.0792  
7610 FPB-9-70C FP-9 -70C 080987 130 2.1139 64 1.8062 18 1.2553 18 1.2553  
7612 FPB-9-80C FP-9 -80C 080987 128 2.1072 68 1.8325 21 1.3222 21 1.3222  
7613 FPB-9-80C FP-9 -80C 080987 128 2.1072 68 1.8325 21 1.3222 21 1.3222

MEAN 1.8995 3 0.4771 400 2.6021  
VARIANCE 1.8941 1.3253 2.6944  
0.0668 0.1080 0.0576

7721 FPB-10-5 FP-10 -5 081087 90 1.9542 14 1.1461 170 2.2304 170 2.2304  
7720 FPB-10-4 FP-10 -4 081087 52 1.7160 16 1.2041 170 2.2304 170 2.2304  
7722 FPB-10-6 FP-10 -6 081087 68 1.8325 26 1.4150 120 2.0792 120 2.0792  
7723 FPB-10-7 FP-10 -7 081087 70 1.8451 28 1.4472 180 2.2553 180 2.2553

|      |            |            |          |     |        |          |        |          |        |
|------|------------|------------|----------|-----|--------|----------|--------|----------|--------|
| 7726 | FP8-10-10  | FP-10 -10  | 081087   | 118 | 2 0719 | 24       | 1 3902 | 136      | 2 1335 |
| 7725 | FP8-10-9   | FP-10 -9   | 081087   | 84  | 1 9243 | 26       | 1 4150 | 72       | 1 8573 |
| 7717 | FP8-10-1   | FP-10 -1   | 081087   | 70  | 1 6451 | 16       | 1 2041 | 370      | 2 5682 |
| 7724 | FP8-10-8   | FP-10 -8   | 081087   | 128 | 2 1072 | 46       | 1 6628 | 134      | 2 1271 |
| 7718 | FP-10-2    | FP-10 -2   | 081087   | 60  | 1 7782 | 14       | 1 1461 | 290      | 2 4624 |
| 7719 | FP-10-3    | FP-10 -3   | 081087   | 48  | 1 6812 | 16       | 1 2041 | 250      | 2 3979 |
| 7727 | FP8-10-11  | FP-10 -11  | 081087   | 4   | 0 6021 | -2       | 0 3010 | 60       | 1 7782 |
|      |            |            | MEAN     |     | 1 8756 | MEAN     | 1 3225 | MEAN     | 2 2342 |
|      |            |            | VARIANCE |     | 0 0177 | VARIANCE | 0 0256 | VARIANCE | 0 0379 |
| 7735 | FP8-11-8   | FP-11 -8   | 081087   | 50  | 1 6990 | 22       | 1 3424 | 820      | 2 9138 |
| 7736 | FP8-11-9   | FP-11 -9   | 081087   | 64  | 1 8042 | 18       | 1 2553 | 3200     | 3 5051 |
| 7737 | FP8-11-10  | FP-11 -10  | 081087   | 70  | 1 8451 | 18       | 1 2553 | 6200     | 3 7924 |
| 7729 | FP8-11-2   | FP-11 -2   | 081087   | 52  | 1 7160 | 20       | 1 3010 | 120      | 2 0772 |
| 7734 | FP8-11-7   | FP-11 -7   | 081087   | 36  | 1 5563 | 14       | 1 1461 | 150      | 2 1761 |
| 7730 | FP8-11-3   | FP-11 -3   | 081087   | 58  | 1 7634 | 16       | 1 2041 | 89       | 1 9445 |
| 7733 | FP8-11-6   | FP-11 -6   | 081087   | 62  | 1 7924 | 20       | 1 3010 | 128      | 2 1072 |
| 7728 | FP8-11-1   | FP-11 -1   | 081087   | 284 | 2 4533 | 54       | 1 7324 | 310      | 2 4914 |
| 7731 | FP8-11-4   | FP-11 -4   | 081087   | 54  | 1 7324 | 22       | 1 3424 | 122      | 2 0864 |
| 7732 | FP8-11-5   | FP-11 -5   | 081087   | 52  | 1 7160 | 20       | 1 3010 | 115      | 2 0607 |
| 7738 | FP8-11-11  | FP-11 -11  | 081087   | 6   | 0 7782 | -2       | 0 3010 | 1180     | 3 0719 |
| 7739 | FP8-11-11R | FP-11 -11R | 081087   | 4   | 0 6021 | 2        | 0 3010 | 1170     | 3 0682 |
|      |            |            | MEAN     |     | 1 7144 | MEAN     | 1 2257 | MEAN     | 2 5462 |
|      |            |            | VARIANCE |     | 0 1347 | VARIANCE | 0 1059 | VARIANCE | 0 3854 |
| 7782 | FP8-12-5   | FP-12 -5   | 081187   | 60  | 1 7782 | 38       | 1 5798 | 116      | 2 0645 |
| 7787 | FP8-12-10  | FP-12 -10  | 081187   | 52  | 1 7160 | 19       | 1 2788 | 82       | 1 9138 |
| 7778 | FP8-12-1   | FP-12 -1   | 081187   | 550 | 2 7404 | 390      | 2 5911 | 64       | 1 8062 |
| 7785 | FP8-12-8   | FP-12 -8   | 081187   | 50  | 1 6990 | 30       | 1 4771 | 220      | 2 3424 |
| 7779 | FP8-12-2   | FP-12 -2   | 081187   | 63  | 1 9191 | 26       | 1 4150 | 48       | 1 6812 |
| 7783 | FP8-12-6   | FP-12 -6   | 081187   | 42  | 1 6232 | 34       | 1 5315 | 83       | 1 9191 |
| 7786 | FP8-12-9   | FP-12 -9   | 081187   | 60  | 1 7782 | 25       | 1 3779 | 70       | 1 8451 |
| 7781 | FP8-12-4   | FP-12 -4   | 081187   | 340 | 2 5315 | 145      | 2 1614 | 81       | 1 9085 |
| 7784 | FP8-12-7   | FP-12 -7   | 081187   | 74  | 1 8492 | 21       | 1 3222 | 142      | 2 1523 |
| 7780 | FP8-12-3   | FP-12 -3   | 081187   | 73  | 1 8633 | 53       | 1 7243 | 62       | 1 7724 |
| 7789 | FP8-12-11  | FP-12 -11  | 081187   | 34  | 1 5315 | 15       | 1 1761 | 220      | 2 3424 |
|      |            |            | MEAN     |     | 1 9136 | MEAN     | 1 6050 | MEAN     | 1 9789 |
|      |            |            | VARIANCE |     | 0 1293 | VARIANCE | 0 1607 | VARIANCE | 0 0441 |
| 7184 | LB-1-1     | LB-1-1     | 080287   | 28  | 1 4472 | 11       | 1 0414 | 19       | 1 2789 |
| 7229 | LB-1-10    | LB-1-10    | 080287   | 11  | 1 0414 | 9        | 0 9542 | 33       | 1 5185 |
| 7189 | LB-1-2     | LB-1-2     | 080287   | 16  | 1 2041 | 4        | 0 6021 | 41       | 1 6128 |
| 7194 | LB-1-3     | LB-1-3     | 080287   | 12  | 1 0772 | 10       | 1 0000 | 14       | 1 1461 |
| 7197 | LB-1-4     | LB-1-4     | 080287   | 8   | 0 9031 | 6        | 0 7782 | 11       | 1 0414 |
| 7204 | LB-1-5     | LB-1-5     | 080287   | 11  | 1 0414 | 9        | 0 9542 | 21       | 1 3222 |

|                 |            |        |      |          |          |        |          |        |
|-----------------|------------|--------|------|----------|----------|--------|----------|--------|
| 7207 LB-1-6     | LB-1-6     | 080287 | 4    | 0.6021   | 1        | 0.0000 | 102      | 2.0086 |
| 7214 LB-1-7     | LB-1-7     | 080287 | 3    | 0.4771   | 3        | 0.4771 | 15       | 1.1761 |
| 7219 LB-1-8     | LB-1-8     | 080287 | 3    | 0.4771   | 2        | 0.3010 | 11       | 1.0414 |
| 7224 LB-1-9     | LB-1-9     | 080287 | 1    | 0.0000   | 1        | 0.0000 | 25       | 1.3979 |
| 7234 LB-1-11    | LB-1-11    | 080287 | 2    | 0.3010   | 2        | 0.3010 | -2       | 0.3010 |
| 7241 LB-1-11R   | LB-1-11R   | 080287 | -2   | 0.3010   | -2       | 0.3010 | 2        | 0.3010 |
|                 |            |        |      | MEAN     | MEAN     |        | MEAN     |        |
|                 |            |        |      | VARIANCE | VARIANCE |        | VARIANCE |        |
|                 |            |        |      | 0.7794   | 0.5827   |        | 1.2586   |        |
|                 |            |        |      | 0.1745   | 0.1407   |        | 0.1646   |        |
| 7185 LB-2-1     | LB-2-1     | 080287 | 60   | 1.7782   | 26       | 1.4150 | 52       | 1.7160 |
| 7230 LB-2-10    | LB-2-10    | 080287 | 4    | 0.6021   | 4        | 0.6021 | 51       | 1.7076 |
| 7190 LB-2-2     | LB-2-2     | 080287 | 28   | 1.4472   | 16       | 1.2041 | 52       | 1.7160 |
| 7195 LB-2-3     | LB-2-3     | 080287 | 6    | 0.7782   | 4        | 0.6021 | 113      | 2.0531 |
| 7200 LB-2-4     | LB-2-4     | 080287 | 1    | 0.0000   | 1        | 0.0000 | 48       | 1.6812 |
| 7205 LB-2-5     | LB-2-5     | 080287 | 9    | 0.9542   | 6        | 0.7782 | 42       | 1.6232 |
| 7210 LB-2-6     | LB-2-6     | 080287 | 5    | 0.6990   | 1        | 0.0000 | 59       | 1.7634 |
| 7215 LB-2-7     | LB-2-7     | 080287 | 9    | 0.9542   | 5        | 0.6990 | 44       | 1.6435 |
| 7220 LB-2-8     | LB-2-8     | 080287 | 4    | 0.6021   | 1        | 0.0000 | 22       | 1.3424 |
| 7225 LB-2-9     | LB-2-9     | 080287 | 3    | 0.4771   | 1        | 0.0000 | 50       | 1.6990 |
| 7235 LB-2-11    | LB-2-11    | 080287 | 2    | 0.3010   | 2        | 0.3010 | 42       | 1.6232 |
| 7242 LB-2-11R   | LB-2-11R   | 080287 | -2   | 0.3010   | -2       | 0.3010 | 46       | 1.6428 |
|                 |            |        |      | MEAN     | MEAN     |        | MEAN     |        |
|                 |            |        |      | 0.7812   | 0.5092   |        | 1.6881   |        |
|                 |            |        |      | 0.2274   | 0.2281   |        | 0.0246   |        |
| 7186 LB-3-1     | LB-3-1     | 080287 | 1090 | 3.0376   | 900      | 2.9542 | 76       | 1.8908 |
| 7231 LB-3-10    | LB-3-10    | 080287 | 3    | 0.4771   | 2        | 0.3010 | 70       | 1.8451 |
| 7191 LB-3-2     | LB-3-2     | 080287 | 620  | 2.7924   | 420      | 2.6232 | 2240     | 3.3502 |
| 7196 LB-3-3     | LB-3-3     | 080287 | 73   | 1.8633   | 51       | 1.7076 | 780      | 2.8921 |
| 7201 LB-3-4     | LB-3-4     | 080287 | 62   | 1.7924   | 59       | 1.7709 | 170      | 2.2304 |
| 7206 LB-3-5     | LB-3-5     | 080287 | 150  | 2.1761   | 120      | 2.0792 | 187      | 2.2718 |
| 7211 LB-3-6     | LB-3-6     | 080287 | 150  | 2.1761   | 100      | 2.0000 | 620      | 2.7724 |
| 7216 LB-3-7     | LB-3-7     | 080287 | 410  | 2.6128   | 220      | 2.3424 | 270      | 2.4314 |
| 7221 LB-3-8     | LB-3-8     | 080287 | 96   | 1.9823   | 46       | 1.6428 | 62       | 1.7924 |
| 7226 LB-3-9     | LB-3-9     | 080287 | 28   | 1.4472   | 17       | 1.2304 | 67       | 1.8261 |
| 7236 LB-3-11    | LB-3-11    | 080287 | 2    | 0.3010   | 2        | 0.3010 | 56       | 1.7482 |
| 7228 LB-3-90C   | LB-3-90C   | 080287 | 37   | 1.5682   | 23       | 1.3617 | 4        | 0.6021 |
| 7227 LB-3-90C   | LB-3-90C   | 080287 | 38   | 1.5798   | 17       | 1.2304 | 92       | 1.9638 |
| 7232 LB-3-100C  | LB-3-100C  | 080287 | 8    | 0.9031   | 4        | 0.6021 | 80       | 1.9031 |
| 7233 LB-3-100C  | LB-3-100C  | 080287 | 12   | 1.0792   | 8        | 0.9031 | 110      | 2.0614 |
| 7240 LB-3-100CR | LB-3-100CR | 080287 | 10   | 1.0000   | 6        | 0.7782 | 104      | 2.0170 |
| 7239 LB-3-100CR | LB-3-100CR | 080287 | 2    | 0.3010   | 2        | 0.3010 | 70       | 1.8451 |
| 7237 LB-3-110C  | LB-3-110C  | 080287 | -2   | 0.3010   | -2       | 0.3010 | 224      | 2.3502 |
| 7238 LB-3-110C  | LB-3-110C  | 080287 | 2    | 0.3010   | 2        | 0.3010 | 94       | 1.9731 |
| 7244 LB-3-110CR | LB-3-110CR | 080287 | -2   | 0.3010   | -2       | 0.3010 | 230      | 2.3617 |
| 7245 LB-3-110CR | LB-3-110CR | 080287 | -2   | 0.3010   | -2       | 0.3010 | 74       | 1.8492 |
| 7243 LB-3-11R   | LB-3-11R   | 080287 | -2   | 0.3010   | -2       | 0.3010 | 86       | 1.9345 |

|               |          |          |          |          |          |          |        |
|---------------|----------|----------|----------|----------|----------|----------|--------|
| 7187 LB-3-10C | 080287   | 720      | 2.8573   | 720      | 2.8573   | 0.10     | 2.9095 |
| 7188 LB-3-10C | 080287   | 610      | 2.7653   | 500      | 2.6990   | 12.30    | 3.0099 |
| 7193 LB-3-20C | 080287   | 320      | 2.5051   | 370      | 2.5051   | 621      | 2.7931 |
| 7192 LB-3-20C | 080287   | 450      | 2.6532   | 450      | 2.6532   | 600      | 2.8325 |
| 7197 LB-3-30C | 080287   | 90       | 1.9542   | 63       | 1.7993   | 56       | 1.7482 |
| 7198 LB-3-30C | 080287   | 108      | 2.0334   | 85       | 1.9294   | 107      | 2.0294 |
| 7202 LB-3-40C | 080287   | 61       | 1.7853   | 31       | 1.4914   | 570      | 2.7559 |
| 7203 LB-3-40C | 080287   | 91       | 1.9590   | 20       | 1.4472   | 930      | 2.9485 |
| 7207 LB-3-50C | 080287   | 100      | 2.0000   | 100      | 2.0000   | 189      | 2.2785 |
| 7208 LB-3-50C | 080287   | 120      | 2.0792   | 110      | 2.0414   | 64       | 1.8062 |
| 7213 LB-3-60C | 080287   | 180      | 2.2553   | 100      | 2.0000   | 157      | 2.1959 |
| 7212 LB-3-60C | 080287   | 180      | 2.2553   | 100      | 2.0000   | 260      | 2.4150 |
| 7218 LB-3-70C | 080287   | 400      | 2.6021   | 170      | 2.2304   | 168      | 2.2253 |
| 7217 LB-3-70C | 080287   | 420      | 2.6232   | 260      | 2.4150   | 146      | 2.1644 |
| 7223 LB-3-80C | 080287   | 77       | 1.8665   | 54       | 1.7324   | 175      | 2.2430 |
| 7222 LB-3-80C | 080287   | 67       | 1.8261   | 50       | 1.6970   | 53       | 1.7243 |
|               | MEAN     | MEAN     | MEAN     | MEAN     | MEAN     | MEAN     |        |
|               | VARIANCE | VARIANCE | VARIANCE | VARIANCE | VARIANCE | VARIANCE |        |
|               |          |          | 1.8780   | 1.7248   | 1.7248   | 2.2783   |        |
|               |          |          | 0.6865   | 0.6551   | 0.6551   | 0.2621   |        |
| 7335 LB-4-1   | 080387   | 620      | 2.7924   | 310      | 2.4914   | 10       | 1.0000 |
| 7344 LB-4-10  | 080387   | 67       | 1.8261   | 36       | 1.5563   | 91       | 1.9590 |
| 7336 LB-4-2   | 080387   | 240      | 2.3802   | 100      | 2.0000   | 89       | 1.9445 |
| 7337 LB-4-3   | 080387   | 48       | 1.6812   | 32       | 1.5051   | 32       | 1.5051 |
| 7338 LB-4-4   | 080387   | 133      | 2.1239   | 102      | 2.0086   | 10       | 1.0000 |
| 7339 LB-4-5   | 080387   | 116      | 2.0645   | 92       | 1.9638   | 2        | 0.3010 |
| 7340 LB-4-6   | 080387   | 111      | 2.0453   | 79       | 1.8976   | 3        | 0.4771 |
| 7341 LB-4-7   | 080387   | 42       | 1.6232   | 42       | 1.6232   | 4        | 0.6021 |
| 7342 LB-4-8   | 080387   | 37       | 1.5911   | 20       | 1.3010   | 32       | 1.5051 |
| 7343 LB-4-9   | 080387   | 30       | 1.4771   | 24       | 1.3802   | 13       | 1.1139 |
| 7345 LB-4-11  | 080387   | 34       | 1.5315   | 17       | 1.2304   | 7        | 0.8451 |
|               | MEAN     | MEAN     | MEAN     | MEAN     | MEAN     | MEAN     |        |
|               | VARIANCE | VARIANCE | VARIANCE | VARIANCE | VARIANCE | VARIANCE |        |
|               |          |          | 1.9215   | 1.7234   | 1.7234   | 1.1139   |        |
|               |          |          | 0.1509   | 0.1378   | 0.1378   | 0.2852   |        |
| 7346 LB-5-1   | 080387   | 120      | 2.0792   | 58       | 1.7634   | 29       | 1.4624 |
| 7355 LB-5-10  | 080387   | 120      | 2.0792   | 100      | 2.0000   | 20       | 1.3010 |
| 7347 LB-5-2   | 080387   | 60       | 1.7782   | 33       | 1.5185   | 25       | 1.3979 |
| 7348 LB-5-3   | 080387   | 65       | 1.8129   | 25       | 1.3979   | 25       | 1.3979 |
| 7349 LB-5-4   | 080387   | 124      | 2.0734   | 69       | 1.8325   | 17       | 1.2788 |
| 7350 LB-5-5   | 080387   | 124      | 2.0734   | 69       | 1.8325   | 16       | 1.2041 |
| 7351 LB-5-6   | 080387   | 78       | 1.8921   | 68       | 1.8325   | 18       | 1.2553 |
| 7352 LB-5-7   | 080387   | 124      | 2.0734   | 70       | 1.8451   | 16       | 1.2041 |
| 7353 LB-5-8   | 080387   | 130      | 2.1139   | 60       | 1.7702   | 12       | 1.0772 |
| 7354 LB-5-9   | 080387   | 146      | 2.1644   | 62       | 1.7924   | 7        | 0.8451 |
| 7356 LB-5-11  | 080387   | -2       | 0.3010   | -2       | 0.3010   | 2        | 0.3010 |
| 7357 LB-5-10R | 080387   | 80       | 1.9031   | 50       | 1.6970   | 20       | 1.3010 |
| 7358 LB-5-11R | 080387   | 6        | 0.7782   | 6        | 0.7782   | -2       | 0.3010 |



|      |            | MEAN<br>VARIANCE | 1.5117<br>0.0432 | MEAN<br>VARIANCE | 1.1590<br>0.0493 | MEAN<br>VARIANCE | 2.3556<br>0.0248 |
|------|------------|------------------|------------------|------------------|------------------|------------------|------------------|
| 7636 | LB-9-1     | 080987           | 1.8129           | 47               | 1.6721           | 9                | 0.9542           |
| 7663 | LB-9-10    | 080987           | 0.9031           | 7                | 0.8451           | 19               | 1.2788           |
| 7639 | LB-9-2     | 080987           | 1.5441           | 22               | 1.3424           | 13               | 1.1139           |
| 7642 | LB-9-3     | 080987           | 2.1987           | 105              | 2.0212           | 3                | 0.4771           |
| 7645 | LB-9-4     | 080987           | 1.5315           | 16               | 1.2041           | 15               | 1.1761           |
| 7648 | LB-9-5     | 080987           | 1.5778           | 25               | 1.3979           | 21               | 1.3222           |
| 7651 | LB-9-6     | 080987           | 0.9542           | 8                | 0.9031           | 200              | 2.3010           |
| 7654 | LB-9-7     | 080987           | 1.1761           | 5                | 0.8990           | 9                | 0.9542           |
| 7660 | LB-9-9     | 080987           | 1.6451           | 4                | 0.6021           | 200              | 2.3010           |
| 7657 | LB-9-8     | 080987           | 1.0000           | 9                | 0.9542           | 15               | 1.1761           |
| 7666 | LB-9-11    | 080987           | 0.0000           | 1                | 0.0000           | 77               | 1.8065           |
| 7644 | LB-9-100C  | 080987           | 0.0000           | 1                | 0.0000           | 69               | 1.8388           |
| 7645 | LB-9-100C  | 080987           | 1.0000           | 3                | 0.6771           | 47               | 1.6721           |
| 7648 | LB-9-110C  | 080987           | 0.3010           | -2               | 0.3010           | 98               | 1.9912           |
| 7667 | LB-9-110C  | 080987           | 0.3010           | -2               | 0.3010           | 90               | 1.9542           |
| 7669 | LB-9-110CR | 080987           | 0.3010           | -2               | 0.3010           | 80               | 1.9031           |
| 7670 | LB-9-110CR | 080987           | 0.3010           | -2               | 0.3010           | 114              | 2.0569           |
| 7637 | LB-9-10C   | 080987           | 1.6990           | 35               | 1.5441           | 3                | 0.4771           |
| 7638 | LB-9-10C   | 080987           | 1.6912           | 34               | 1.5543           | 300              | 2.4771           |
| 7640 | LB-9-20C   | 080987           | 1.4472           | 19               | 1.2788           | 5                | 0.8990           |
| 7641 | LB-9-20C   | 080987           | 1.3979           | 16               | 1.2041           | 400              | 2.6021           |
| 7644 | LB-9-30C   | 080987           | 2.1072           | 94               | 1.9731           | 3                | 0.4771           |
| 7643 | LB-9-30C   | 080987           | 2.0531           | 77               | 1.8945           | 12               | 1.0792           |
| 7647 | LB-9-40C   | 080987           | 1.5315           | 22               | 1.3424           | 18               | 1.2553           |
| 7646 | LB-9-40C   | 080987           | 1.6021           | 29               | 1.4624           | 30               | 1.4771           |
| 7649 | LB-9-50C   | 080987           | 1.5682           | 26               | 1.4150           | 22               | 1.3424           |
| 7650 | LB-9-50C   | 080987           | 1.4771           | 24               | 1.3902           | 19               | 1.2788           |
| 7652 | LB-9-60C   | 080987           | 0.8451           | 5                | 0.8990           | 200              | 2.3010           |
| 7653 | LB-9-60C   | 080987           | 1.0000           | 8                | 0.9031           | 2                | 0.3010           |
| 7655 | LB-9-70C   | 080987           | 1.1761           | 9                | 0.9542           | 20               | 1.3010           |
| 7656 | LB-9-70C   | 080987           | 1.0792           | 6                | 0.7782           | 45               | 1.6532           |
| 7659 | LB-9-80C   | 080987           | 1.0414           | 11               | 1.0414           | 13               | 1.1139           |
| 7658 | LB-9-80C   | 080987           | 0.9031           | 8                | 0.9031           | 65               | 1.8129           |
| 7662 | LB-9-90C   | 080987           | 1.0000           | 9                | 0.9542           | 300              | 2.4771           |
| 7661 | LB-9-90C   | 080987           | 0.6021           | 4                | 0.6021           | 32               | 1.5051           |
|      |            | MEAN<br>VARIANCE | 1.2316<br>0.3172 | MEAN<br>VARIANCE | 1.0583<br>0.2781 | MEAN<br>VARIANCE | 1.3583<br>0.2994 |
| 7671 | LB-10-1    | 081087           | 1.7243           | 35               | 1.5441           | 240              | 2.3802           |
| 7680 | LB-10-10   | 081087           | 0.9542           | 7                | 0.8451           | 170              | 2.2304           |
| 7672 | LB-10-2    | 081087           | 1.7482           | 50               | 1.6990           | 64               | 1.8062           |
| 7673 | LB-10-3    | 081087           | 1.4150           | 26               | 1.4150           | 170              | 2.2304           |
| 7674 | LB-10-4    | 081087           | 1.6129           | 41               | 1.6129           | 180              | 2.2553           |



|                |        |          |        |          |        |          |        |
|----------------|--------|----------|--------|----------|--------|----------|--------|
| 7675 LB-10-5   | 081087 | 16       | 1.2041 | 13       | 1.1139 | 3500     | 3.5441 |
| 7676 LB-10-6   | 081087 | 25       | 1.3779 | 15       | 1.1761 | 90       | 1.9542 |
| 7677 LB-10-7   | 081087 | 17       | 1.2304 | 6        | 0.7782 | 1700     | 3.2304 |
| 7678 LB-10-8   | 081087 | 8        | 0.9031 | 8        | 0.9031 | 87       | 1.9375 |
| 7679 LB-10-9   | 081087 | 27       | 1.4314 | 20       | 1.3010 | 121      | 2.0028 |
| 7681 LB-10-11  | 081087 | 2        | 0.3010 | 1        | 0.0000 | 210      | 2.3222 |
|                |        | MEAN     | 1.2857 | MEAN     | 1.1262 | MEAN     | 2.3614 |
|                |        | VARIANCE | 0.1632 | VARIANCE | 0.2158 | VARIANCE | 0.2665 |
| 7682 LB-11-1   | 081087 | 35       | 1.5441 | 23       | 1.3617 | 170      | 2.0777 |
| 7691 LB-11-10  | 081087 | 10       | 1.0000 | 4        | 0.6021 | 76       | 1.6009 |
| 7683 LB-11-2   | 081087 | 61       | 1.7853 | 43       | 1.6335 | 140      | 2.1461 |
| 7694 LB-11-3   | 081087 | 46       | 1.6628 | 28       | 1.4472 | 150      | 2.1761 |
| 7685 LB-11-4   | 081087 | 18       | 1.2553 | 10       | 1.0000 | 230      | 2.3617 |
| 7686 LB-11-5   | 081087 | 11       | 1.0414 | 8        | 0.9031 | 200      | 2.3010 |
| 7687 LB-11-6   | 081087 | 5        | 0.6990 | 5        | 0.6990 | 130      | 2.1139 |
| 7688 LB-11-7   | 081087 | 6        | 0.7782 | 4        | 0.6021 | 200      | 2.3010 |
| 7689 LB-11-8   | 081087 | 5        | 0.6990 | 5        | 0.6990 | 91       | 1.9590 |
| 7690 LB-11-9   | 081087 | 6        | 0.7782 | 4        | 0.6021 | 140      | 2.1461 |
| 7692 LB-11-11  | 081087 | -2       | 0.3010 | -2       | 0.3010 | 1050     | 3.0212 |
| 7693 LB-11-11R | 081087 | -2       | 0.3010 | -2       | 0.3010 | 1500     | 3.1761 |
|                |        | MEAN     | 1.0495 | MEAN     | 0.8955 | MEAN     | 2.2260 |
|                |        | VARIANCE | 0.1964 | VARIANCE | 0.1606 | VARIANCE | 0.0820 |
| 7789 LB-12-1   | 081187 | 50       | 1.6990 | 5        | 0.6990 | 75       | 1.8751 |
| 7798 LB-12-10  | 081187 | 32       | 1.5051 | 16       | 1.2041 | 34       | 1.5315 |
| 7790 LB-12-2   | 081187 | 86       | 1.9345 | 23       | 1.3617 | 78       | 1.8921 |
| 7791 LB-12-3   | 081187 | 41       | 1.6128 | 12       | 1.0792 | 68       | 1.8325 |
| 7792 LB-12-4   | 081187 | 30       | 1.4771 | 13       | 1.1139 | 45       | 1.6532 |
| 7793 LB-12-5   | 081187 | 51       | 1.7076 | 14       | 1.1461 | 63       | 1.7993 |
| 7794 LB-12-6   | 081187 | 34       | 1.5315 | 10       | 1.0000 | 50       | 1.6990 |
| 7795 LB-12-7   | 081187 | 54       | 1.7324 | 15       | 1.1761 | 80       | 1.9031 |
| 7796 LB-12-8   | 081187 | 39       | 1.5911 | 3        | 0.4771 | 61       | 1.7853 |
| 7797 LB-12-9   | 081187 | 35       | 1.5441 | 13       | 1.1139 | 43       | 1.6335 |
| 7799 LB-12-11  | 081187 | 106      | 2.0253 | 14       | 1.1461 | 156      | 2.1931 |
| 7800 LB-12-11R | 081187 | 120      | 2.0792 | 6        | 0.7782 | 132      | 2.1206 |
|                |        | MEAN     | 1.6691 | MEAN     | 1.0470 | MEAN     | 1.7998 |
|                |        | VARIANCE | 0.0283 | VARIANCE | 0.0562 | VARIANCE | 0.0284 |
| 7013 HLE1NG    | 072987 | 160000   | 5.2041 | 50000    | 4.6990 | 1600     | 3.2041 |
| 7016 HLE2HG    | 072987 | 5000000  | 6.6990 | 5000000  | 6.6990 | 1650     | 3.2175 |
| 7039 HLE2HG    | 073087 | 44000000 | 7.6435 | 39000000 | 7.5911 | 140      | 2.1461 |
| 7044 HLE3HG    | 073087 | 92000000 | 7.9636 | 91000000 | 7.9590 | 23000    | 4.3617 |
| 7067 HLE3HG    | 073187 | 16000000 | 7.2041 | 8000000  | 6.9031 | -100     | 2.0000 |

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7073 HLE4HG 073187 21000000 7.3227 20000000 7.3010 1220 3.0844  
 7091 HLE4NG 080187 47000000 7.6721 45000000 7.6532 4000 3.6021  
 7094 HLE5HG 080187 29000000 7.4624 26000000 7.4150 150 2.1781  
 7068 HLE3HGOC 073187 12000000 7.0772 10000000 7.0000 100 2.0000  
 7045 HLE4HGOC 073087 1599777 6.2041 1599777 6.2041 1000 3.0000  
 7069 HLE3GCS 073187 2400000 6.3802 2000000 6.3010 340 2.5315  
 7074 HLE4GCS 073187 20000000 7.4472 26000000 7.4150 640 2.8195

MEAN 7.1664 7.0275 2.9742  
 VARIANCE 0.6623 0.9184 0.5875

7751 HRLJHG 081087 20000000 8.3010 15000000 8.1761 370000 6.5682  
 7748 HRLJNG 081087 113000000 9.0531 14000000 8.1461 700000 6.8976  
 7755 HRLJZG 081187 55000000 8.7404 30000000 8.4771 9500 3.9777  
 7824 HRLJZG 081187 11000000 8.0414 35000000 7.5441 210000 5.3222  
 7821 HRLJG 081287 67000000 8.8308 34000000 8.5315 31000 4.4914  
 7821 HRLJG 081287 160000000 9.2041 56000000 8.7482 7000 3.8451  
 7844 HRLJHG 081387 190000000 9.1761 57000000 8.7559 1000 3.0000  
 7847 HRLJHG 081387 169000000 9.1732 72000000 8.8573 -100 2.0000  
 7850 HRLJG 081387 65000000 8.8129 41000000 8.6128 100 2.0000  
 7818 HRLJGOC 081287 148000000 9.1703 66000000 8.8195 4000 3.6021  
 7817 HRLJGOC 081287 129000000 9.1106 36000000 8.5315 2100 3.3222  
 7752 HRLJHGR 081087 25000000 8.3979 17000000 8.2304 750000 6.8751  
 7851 HRLJGR 081387 66000000 8.8195 34000000 8.5315 100 2.0000

MEAN 8.8157 8.4277 4.2336  
 VARIANCE 0.1484 0.1518 2.8350

7428 HBY1HG 080587 95000000 7.9777 12000000 7.0772 -1000 3.0000  
 7462 HBY2HG 080787 79000000 8.8976 36000000 8.5563 -10000 4.0000  
 7430 HBY2HG 080587 89000000 8.9494 29000000 8.4424 100000 5.0000  
 7432 HBY3HG 080587 22000000 7.3424 6000000 6.7782 -10000 4.0000  
 7474 HBY3HG 080787 137000000 8.1367 137000000 8.1367 -10000 4.0000  
 7476 HBY4HG 080787 107000000 8.0294 107000000 8.0294 -10000 4.0000  
 7479 HBY4HG 080787 48000000 8.4812 30000000 7.4771 -10000 4.0000  
 7470 HBY3GOC 080787 10400000 8.0170 10400000 8.0170 -10000 4.0000  
 7471 HBY3GOC 080787 131000000 8.1173 131000000 8.1173 -10000 4.0000  
 7463 HBY2GCS 080787 4700000 6.6721 4700000 6.6721 -10000 4.0000  
 7464 HBY2GCS 080787 65000000 8.8129 60000000 7.7782 -10000 4.0000

MEAN 8.2878 7.7885 4.0000  
 VARIANCE 0.2920 0.4063 0.2857

7014 HLE1NH 072787 10000 4.0000 4.0000 1400 3.1461  
 7017 HLE2NH 072787 12000000 7.0772 6000000 6.7782 10 1.0000  
 7038 HLE2NH 073087 26000 4.4150 4.3617 410 2.6128  
 7042 HLE3NH 073087 36000000 7.5563 1600000 7.2041 2000 3.3010

|               |          |        |          |        |          |        |          |        |
|---------------|----------|--------|----------|--------|----------|--------|----------|--------|
| 7066 HLE3H1   | HLE3H1 H | 073187 | 67000000 | 6.6702 | 37000000 | 6.5911 | 3000     | 3.4771 |
| 7071 HLE4H1   | HLE4H1 H | 073187 | 18000000 | 7.2553 | 15000000 | 7.1761 | 1500     | 3.1761 |
| 7090 HLE4H1   | HLE4H1 H | 080187 | 25000000 | 7.3979 | 21000000 | 7.3722 | 2000     | 3.3010 |
| 7093 HLE5H1   | HLE5H1 H | 080187 | 26000000 | 7.4150 | 23000000 | 7.3617 | 19000    | 4.2788 |
| 7043 HLE4H1OC | HLE4H1OC | 073087 | 75000000 | 6.8751 | 73000000 | 6.8633 | 1400     | 3.1661 |
| 7072 HLE3H1OC | HLE3H1OC | 073187 | 39000000 | 7.5911 | 30000000 | 7.4771 | 3600     | 3.5563 |
|               |          |        | MEAN     | 6.4761 | MEAN     | 6.3694 | MEAN     | 3.0344 |
|               |          |        | VARIANCE | 1.7068 | VARIANCE | 1.6372 | VARIANCE | 0.7795 |
| 7750 HRU1H1   | HRU1H1 H | 081087 | 66000000 | 6.8325 | 20000000 | 5.3010 | 3000     | 3.4771 |
| 7767 HRU1H1   | HRU1H1 H | 081087 | 81000000 | 6.9085 | 60000000 | 5.7702 | 5000     | 3.6980 |
| 7754 HRU2H1   | HRU2H1 H | 081187 | 12000000 | 7.0792 | 50000000 | 6.6970 | 47000    | 4.6721 |
| 7757 HRU2H1   | HRU2H1 H | 081187 | 62000000 | 6.7924 | 33000000 | 6.5185 | 5100     | 3.7076 |
| 7823 HRU3H1   | HRU3H1 H | 081287 | 40000000 | 7.6021 | 11000000 | 7.0614 | 31000    | 4.4914 |
| 7820 HRU3H1   | HRU3H1 H | 081287 | 16000000 | 7.2041 | 73000000 | 6.8633 | 16000    | 4.2041 |
| 7825 HRU3H1   | HRU3H1 H | 081287 | 15200000 | 7.1818 | 28000000 | 6.6472 | 30000    | 4.4771 |
| 7843 HRU4H1   | HRU4H1 H | 081387 | 18000000 | 7.2553 | 70000000 | 6.8451 | 11000    | 4.0414 |
| 7846 HRU4H1   | HRU4H1 H | 081387 | 16700000 | 7.1673 | 48000000 | 6.6812 | 17000    | 4.2304 |
| 7849 HRU5H1   | HRU5H1 H | 081387 | 18000000 | 7.2553 | 80000000 | 6.9031 | 36000    | 4.5563 |
| 7816 HRU3H1OC | HRU3H1OC | 081287 | 10400000 | 7.0253 | 72000000 | 6.8573 | 25000    | 4.3979 |
| 7815 HRU3H1OC | HRU3H1OC | 081287 | 13600000 | 7.1335 | 27000000 | 6.4314 | 31000    | 4.4914 |
|               |          |        | MEAN     | 7.1278 | MEAN     | 6.5078 | MEAN     | 4.1557 |
|               |          |        | VARIANCE | 0.0518 | VARIANCE | 0.2740 | VARIANCE | 0.1534 |
| 7427 HBY1H1   | HBY1H1 H | 080587 | 80000000 | 6.9031 | 40000000 | 6.6021 | 3000     | 3.4771 |
| 7461 HBY2H1   | HBY2H1 H | 080787 | 61000000 | 6.7853 | 27000000 | 6.4314 | 60000    | 4.7782 |
| 7429 HBY2H1   | HBY2H1 H | 080587 | 10300000 | 7.0128 | 60000000 | 5.7782 | 40000    | 4.6021 |
| 7431 HBY3H1   | HBY3H1 H | 080587 | 13000000 | 7.1139 | 37000000 | 6.5682 | 80000    | 4.9031 |
| 7473 HBY3H1   | HBY3H1 H | 080787 | 23000000 | 7.3617 | 50000000 | 5.6990 | 30000    | 4.4771 |
| 7475 HBY4H1   | HBY4H1 H | 080787 | 17000000 | 7.2304 | 17000000 | 7.2304 | 60000    | 4.7782 |
| 7478 HBY4H1   | HBY4H1 H | 080787 | 36000000 | 6.5563 | 36000000 | 6.5563 | 25000    | 4.3979 |
| 7469 HBY3H1OC | HBY3H1OC | 080787 | 12300000 | 7.0899 | 37000000 | 6.5682 | 20000    | 4.3010 |
| 7468 HBY3H1OC | HBY3H1OC | 080787 | 29000000 | 7.4624 | 60000000 | 6.7782 | 29000    | 4.4624 |
|               |          |        | MEAN     | 6.9948 | MEAN     | 6.4094 | MEAN     | 4.4877 |
|               |          |        | VARIANCE | 0.0642 | VARIANCE | 0.2374 | VARIANCE | 0.1977 |
| 7015 HLE1S    | HLE1S S  | 072987 | 27000000 | 7.4314 | 22000000 | 7.3424 | 840      | 2.9243 |
| 7018 HLE2S    | HLE2S S  | 072987 | 110000   | 5.0614 | 20000    | 4.3010 | 1460     | 3.1644 |
| 7037 HLE2S    | HLE2S S  | 073087 | 31000000 | 6.4914 | 15000000 | 6.1761 | 830      | 2.9191 |
| 7040 HLE3S    | HLE3S S  | 073087 | 30000000 | 7.4771 | 80000000 | 6.9031 | 140      | 2.1461 |
| 7065 HLE3S    | HLE3S S  | 073187 | 130000   | 5.1139 | 30000    | 4.4771 | -10      | 1.0000 |
| 7070 HLE4S    | HLE4S S  | 073187 | 13000    | 4.1139 | 8000     | 3.9031 | -100     | 2.0000 |
| 7069 HLE4S    | HLE4S S  | 080187 | 42000000 | 6.6232 | 7000000  | 5.8451 | -100     | 2.0000 |
| 7092 HLE5S    | HLE5S S  | 080187 | 26000000 | 6.4150 | 21000000 | 6.3222 | -100     | 2.0000 |

|               |           |        |            |        |            |        |          |        |
|---------------|-----------|--------|------------|--------|------------|--------|----------|--------|
| 7041 HLE3F60C | HLE3H SOC | 073087 | 300000000  | 7.4771 | 130000000  | 7.1139 | 120      | 2.0772 |
|               |           |        | MEAN       | 6.0004 | MEAN       | 5.6506 | MEAN     | 2.2692 |
|               |           |        | VARIANCE   | 1.2789 | VARIANCE   | 1.4310 | VARIANCE | 0.4370 |
| 7749 HRJ1H6   | HRJ1H S   | 081087 | 25000000   | 6.3979 | 1000000    | 6.0000 | -100     | 2.0000 |
| 7746 HRJ1H6   | HRJ1H S   | 081087 | 65000000   | 6.8129 | 8000000    | 5.9031 | 100      | 2.0000 |
| 7753 HRJ2H6   | HRJ2H S   | 081187 | 61000000   | 6.7853 | 35000000   | 6.5441 | 28000    | 4.4472 |
| 7756 HRJ2H6   | HRJ2H S   | 081187 | 50000000   | 6.6970 | 50000000   | 6.6970 | 10400    | 4.0170 |
| 7822 HRJ3H6   | HRJ3H S   | 081287 | 550000000  | 7.7404 | 200000000  | 7.3010 | 23000    | 4.3617 |
| 7819 HRJ3H6   | HRJ3H S   | 081287 | 144000000  | 7.1584 | 46000000   | 6.6628 | 24000    | 4.3802 |
| 7842 HRJ4H6   | HRJ4H S   | 081387 | 1190000000 | 8.0755 | 760000000  | 7.8808 | 2000     | 3.3010 |
| 7845 HRJ4H6   | HRJ4H S   | 081387 | 410000000  | 7.6128 | 300000000  | 7.5778 | 7000     | 3.8451 |
| 7848 HRJ5H6   | HRJ5H S   | 081387 | 190000000  | 7.2788 | 1000000    | 6.0000 | 39000    | 4.5911 |
| 7814 HRJ3F60C | HRJ3H SOC | 081287 | 420000000  | 7.6232 | 6000000    | 6.7782 | 220000   | 5.3424 |
| 7813 HRJ3F60C | HRJ3H SOC | 081287 | 270000000  | 7.4314 | 1000000    | 6.0000 | 80000    | 4.9031 |
|               |           |        | MEAN       | 7.1734 | MEAN       | 6.7301 | MEAN     | 3.6604 |
|               |           |        | VARIANCE   | 0.2719 | VARIANCE   | 0.4625 | VARIANCE | 0.9222 |
| 7426 HBY1H6   | HBY1H S   | 080587 | 440000     | 5.6435 | 410000     | 5.6128 | 1300     | 3.1139 |
| 7447 HBY3H6   | HBY3H S   | 080787 | 500000     | 5.6970 | 500000     | 5.6970 | 690000   | 5.8388 |
| 7466 HBY3F60C | HBY3H SOC | 080787 | 520000     | 5.7160 | 240000     | 5.3802 | 90000    | 4.9542 |
| 7465 HBY3F60C | HBY3H SOC | 080787 | 580000     | 5.7634 | 220000     | 5.3424 | 60000    | 4.7782 |
|               |           |        | MEAN       | 5.6712 | MEAN       | 5.6559 | MEAN     | 4.4764 |
|               |           |        | VARIANCE   | 0.0008 | VARIANCE   | 0.0019 | VARIANCE | 1.0563 |
| 7399 P081H6   | P081H G   | 080487 | 1000000    | 6.0000 | -1000000   | 6.0000 | 10000    | 4.0000 |
| 7402 P082H6   | P082H G   | 080487 | 920000000  | 7.9638 | 740000000  | 7.8692 | 3000000  | 6.4771 |
| 7404 P082H6S  | P082H GS  | 080487 | 2500000000 | 8.3979 | 6000000    | 6.7782 | 2500000  | 6.3979 |
| 7425 P083H6   | P083H G   | 080587 | 18000000   | 7.2553 | 18000000   | 7.2553 | 22000000 | 7.3624 |
| 7442 P083H6   | P083H G   | 080687 | 930000000  | 7.9685 | 930000000  | 7.9685 | 3100000  | 6.4914 |
| 7445 P084H6   | P084H G   | 080687 | 1950000000 | 8.2900 | 1500000000 | 8.1761 | 8000000  | 6.9031 |
| 7531 P084H6   | P084H G   | 080687 | 1240000000 | 8.0934 | 124000000  | 8.0934 | -10000   | 4.0000 |
| 7835 P085H6   | P085H G   | 081387 | 9400000000 | 8.9731 | 5100000000 | 8.7076 | 4000     | 3.6021 |
| 7423 P083F60C | P083H GOC | 080587 | 3000000    | 6.4771 | 2000000    | 6.3010 | 23000000 | 7.3617 |
| 7424 P083F60C | P083H GOC | 080587 | 2800000000 | 8.4472 | 2200000000 | 8.3424 | 28000000 | 7.4472 |
| 7532 P084H6R  | P084H GR  | 080687 | 2700000000 | 8.4314 | 2300000000 | 8.3617 | -10000   | 4.0000 |
| 7403 P082H6S  | P082H GS  | 080487 | 65000000   | 7.8129 | 60000000   | 7.7782 | 3400000  | 6.5315 |
|               |           |        | MEAN       | 7.7920 | MEAN       | 7.7243 | MEAN     | 5.5452 |
|               |           |        | VARIANCE   | 0.7563 | VARIANCE   | 0.6544 | VARIANCE | 2.1984 |
| 7007 PCG1H6   | PCG1H G   | 072987 | 18000000   | 7.2553 | 18000000   | 7.2553 | 15999    | 4.2041 |

|      |        |          |        |           |        |           |        |          |        |
|------|--------|----------|--------|-----------|--------|-----------|--------|----------|--------|
| 7010 | PCG2HG | PCG2HG   | 072987 | 6000000   | 6.7782 | 5000000   | 6.6990 | 159999   | 4.2041 |
| 7027 | PCG2HG | PCG2HG   | 073087 | 150000000 | 7.1761 | 110000000 | 7.0414 | 15999    | 3.2038 |
| 7036 | PCG3HG | PCG3HG   | 073087 | 15999999  | 6.2041 | 15999999  | 6.2041 | 15999    | 3.2038 |
| 7059 | PCG3HG | PCG3HG   | 073187 | 28000000  | 7.4472 | 26000000  | 7.4150 | 6500000  | 6.8129 |
| 7063 | PCG4HG | PCG4HG   | 073187 | 24000000  | 7.3802 | 23000000  | 7.3617 | 8400000  | 5.9243 |
| 7263 | PCG4HG | PCG4HG   | 080287 | 5200000   | 6.7160 | 4100000   | 6.6128 | 12000000 | 7.0792 |
| 7266 | PCG3HG | PCG3HG   | 080287 | 36000000  | 7.5563 | 15000000  | 7.1761 | 13000000 | 7.1139 |
| 7060 | PCG3HG | PCG3HG   | 073187 | 56000000  | 7.7482 | 40000000  | 7.6021 | 1000000  | 6.0000 |
| 7064 | PCG4HG | PCG4HG   | 073187 | 11000000  | 7.0414 | 5000000   | 6.6990 | 570000   | 5.7559 |
| 7035 | PCG2HG | PCG2HG   | 073087 | 15999999  | 6.2041 | 15999999  | 6.2041 | 15999    | 3.2038 |
| 7036 | PCG2HG | PCG2HG   | 073087 | 15999999  | 6.2041 | 15999999  | 6.2041 | 15999    | 3.2038 |
|      |        | MEAN     |        | MEAN      |        | MEAN      |        | MEAN     |        |
|      |        | VARIANCE |        | VARIANCE  |        | VARIANCE  |        | VARIANCE |        |
|      |        |          |        | 7.0642    |        | 6.9707    |        | 5.3433   |        |
|      |        |          |        | 0.1851    |        | 0.1585    |        | 2.8197   |        |

|      |        |          |        |           |        |           |        |          |        |
|------|--------|----------|--------|-----------|--------|-----------|--------|----------|--------|
| 7765 | PH1HMG | PH1HMG   | 081087 | 96000000  | 7.9823 | 54000000  | 7.7324 | 910000   | 5.9590 |
| 7762 | PH1HMG | PH1HMG   | 081087 | 150000000 | 8.1761 | 140000000 | 8.1461 | 2100000  | 7.3222 |
| 7761 | PH1HMG | PH1HMG   | 081187 | 40000000  | 7.6021 | 40000000  | 7.6021 | 1500000  | 6.1761 |
| 7765 | PH1HMG | PH1HMG   | 081187 | 21000     | 4.3222 | 20000     | 4.3010 | 78000    | 4.8721 |
| 7812 | PH1HMG | PH1HMG   | 081287 | 54000000  | 7.7324 | 45000000  | 7.6532 | 10700000 | 7.0294 |
| 7803 | PH1HMG | PH1HMG   | 081287 | 84000000  | 7.9243 | 51000000  | 7.7076 | 2300000  | 6.3617 |
| 7829 | PH1HMG | PH1HMG   | 081387 | 190000000 | 8.2788 | 170000000 | 8.2304 | 14600000 | 7.1644 |
| 7832 | PH1HMG | PH1HMG   | 081387 | 260000000 | 8.4150 | 190000000 | 8.2788 | 3700000  | 6.5482 |
| 7763 | PH1HMG | PH1HMG   | 081187 | 164000000 | 8.1594 | 72000000  | 7.8573 | 1000000  | 6.0000 |
| 7764 | PH1HMG | PH1HMG   | 081187 | 17000     | 4.2304 | 17000     | 4.2304 | 61000    | 4.7853 |
| 7810 | PH1HMG | PH1HMG   | 081287 | 35000000  | 7.5441 | 19000000  | 7.2788 | 6400000  | 6.8062 |
| 7811 | PH1HMG | PH1HMG   | 081287 | 68000000  | 7.8325 | 39000000  | 7.5911 | 8500000  | 6.9294 |
| 7838 | PH1HMG | PH1HMG   | 081387 | 115000000 | 8.0607 | 97000000  | 7.9848 | 17200000 | 7.2355 |
| 7839 | PH1HMG | PH1HMG   | 081387 | 280000000 | 8.4472 | 250000000 | 8.3979 | 18000000 | 7.2553 |
|      |        | MEAN     |        | MEAN      |        | MEAN      |        | MEAN     |        |
|      |        | VARIANCE |        | VARIANCE  |        | VARIANCE  |        | VARIANCE |        |
|      |        |          |        | 7.2822    |        | 7.1739    |        | 6.2258   |        |
|      |        |          |        | 2.3125    |        | 2.1676    |        | 0.6843   |        |

|      |        |          |        |          |        |          |        |          |        |
|------|--------|----------|--------|----------|--------|----------|--------|----------|--------|
| 7398 | PO81NH | PO81NH   | 080487 | 400000   | 5.6021 | 400000   | 5.6021 | 101000   | 5.0043 |
| 7401 | PO82NH | PO82NH   | 080487 | 500000   | 5.6990 | 500000   | 5.6990 | 42000    | 4.6232 |
| 7416 | PO82NH | PO82NH   | 080587 | 1620000  | 6.2095 | 1600000  | 6.2041 | 87000    | 4.9395 |
| 7422 | PO83NH | PO83NH   | 080587 | 2600000  | 6.4150 | 3300000  | 5.5185 | 2000     | 3.3010 |
| 7441 | PO83NH | PO83NH   | 080687 | 200000   | 5.3010 | 200000   | 5.3010 | 15000    | 4.1761 |
| 7444 | PO84NH | PO84NH   | 080687 | 13000    | 4.1139 | 13000    | 4.1139 | 8000     | 3.9031 |
| 7530 | PO84NH | PO84NH   | 080887 | 1500000  | 6.1761 | 1500000  | 6.1761 | 490000   | 5.6902 |
| 7833 | PO85NH | PO85NH   | 081387 | 1000000  | 6.0000 | 1000000  | 6.0000 | 300000   | 5.4771 |
| 7421 | PO83NH | PO83NH   | 080587 | 2100000  | 6.3222 | 2300000  | 5.3617 | 2000     | 3.3010 |
| 7420 | PO83NH | PO83NH   | 080587 | 1390000  | 6.1430 | 560000   | 5.7482 | 1000     | 3.0000 |
|      |        | MEAN     |        | MEAN     |        | MEAN     |        | MEAN     |        |
|      |        | VARIANCE |        | VARIANCE |        | VARIANCE |        | VARIANCE |        |
|      |        |          |        | 5.4896   |        | 5.5748   |        | 4.6393   |        |
|      |        |          |        | 0.4714   |        | 0.3958   |        | 0.5722   |        |



|      |           |        |                  |                  |                  |                  |                  |                  |
|------|-----------|--------|------------------|------------------|------------------|------------------|------------------|------------------|
| 7008 | PCGIN H   | 072987 | 2000000          | 6.3010           | 1800000          | 6.2553           | 920              | 2 9639           |
| 7011 | PCGZM H   | 072987 | 300000           | 5.5790           | 100000           | 5.2553           | 700              | 2 8451           |
| 7025 | PCGZM H   | 073087 | 11000            | 4.0416           | 4000             | 3.6021           | 15000            | 4 1761           |
| 7033 | PCGZM H   | 073087 | 52000            | 4.7160           | 44000            | 4.6435           | 58000            | 4 7634           |
| 7058 | PCGZM H   | 073167 | 123000           | 5.0079           | 114000           | 5.0569           | 53000            | 4 7243           |
| 7062 | PCGZM H   | 073167 | 1200000          | 6.0792           | 1150000          | 6.0607           | 51000            | 4 7076           |
| 7262 | PCGZM H   | 080287 | 710000           | 5.8513           | 650000           | 5.8129           | 130000           | 5 1379           |
| 7265 | PCGZM H   | 080287 | 4300000          | 6.6335           | 2400000          | 6.3002           | 6000             | 3 7782           |
| 7032 | PCGZM HOC | 073087 | 800000           | 5.9031           | 130000           | 5.1139           | 44000            | 4 6435           |
|      |           |        | MEAN<br>VARIANCE | 5.5365<br>0.6616 | MEAN<br>VARIANCE | 5.3033<br>0.7801 | MEAN<br>VARIANCE | 4 1373<br>0 6555 |
| 7744 | PH1M H    | 081087 | -10000           | 4.0000           | -10000           | 4.0000           | 15000            | 4 1761           |
| 7741 | PH1M H    | 081087 | 100000           | 5.0000           | 90000            | 4.9542           | 4000             | 3 6021           |
| 7760 | PH1M H    | 081187 | 13000            | 4.1139           | 11000            | 4.0614           | 7700000          | 6 8976           |
| 7809 | PH1M H    | 081287 | 4700000          | 6.6721           | 4300000          | 6.6335           | 640000           | 5 6435           |
| 7802 | PH1M H    | 081287 | 160000           | 5.2041           | 150000           | 5.1761           | 20000            | 4 3010           |
| 7828 | PH1M H    | 081387 | 600000           | 5.7782           | 600000           | 5.7782           | 200000           | 5 3010           |
| 7831 | PH1M H    | 081387 | 120000           | 5.0792           | 120000           | 5.0792           | 40000            | 4 6021           |
| 7807 | PH1M HOC  | 081287 | 5600000          | 6.7634           | 5400000          | 6.7482           | 210000           | 5 3222           |
| 7808 | PH1M HOC  | 081287 | 5500000          | 6.7404           | 5100000          | 6.7076           | 60000            | 4 7782           |
| 7840 | PH1M HOC  | 081387 | 1600000          | 6.1661           | 1000000          | 6.0000           | 161000           | 5 1492           |
| 7841 | PH1M HOC  | 081387 | 1600000          | 6.2041           | 1300000          | 6.1139           | 110000           | 5 0414           |
|      |           |        | MEAN<br>VARIANCE | 5.1211<br>0.7331 | MEAN<br>VARIANCE | 5.0946<br>0.7385 | MEAN<br>VARIANCE | 4 9319<br>1 0505 |
| 7397 | P081N S   | 080487 | 4200000          | 6.6232           | 4200000          | 6.6232           | 131000           | 5 1173           |
| 7400 | P082N S   | 080487 | 7400000          | 6.8692           | 5100000          | 6.7076           | 5200000          | 6 7160           |
| 7415 | P082N S   | 080587 | 1100000          | 6.0414           | 1100000          | 6.0414           | 4300000          | 6 6335           |
| 7419 | P083N S   | 080587 | 3200000          | 5.5051           | 3200000          | 5.5051           | 4200000          | 6 6232           |
| 7440 | P083N S   | 080487 | 2100000          | 6.3222           | 2100000          | 6.3222           | 4100000          | 6 6128           |
| 7443 | P084N S   | 080487 | 700000           | 5.8451           | 700000           | 5.8451           | 1600000          | 6 2041           |
| 7529 | P084N S   | 080887 | 800000           | 5.9031           | 800000           | 5.9031           | 940000           | 5 9731           |
| 7834 | P085N S   | 081387 | 110000000        | 8.0414           | 50000000         | 7.6990           | 15900000         | 7 2014           |
| 7417 | P083N S   | 080587 | 220000           | 5.3424           | 220000           | 5.3424           | 3100000          | 6 4914           |
| 7418 | P083N S   | 080587 | 330000           | 5.5185           | 220000           | 5.3424           | 4700000          | 6 6902           |
|      |           |        | MEAN<br>VARIANCE | 6.3939<br>0.5548 | MEAN<br>VARIANCE | 6 3308<br>0 4105 | MEAN<br>VARIANCE | 6 3952<br>0 3465 |
| 7009 | PCGIN S   | 072987 | 48000000         | 7.6812           | 48000000         | 7.6812           | 740              | 2 8692           |
| 7012 | PCGZM S   | 072987 | 2200000          | 6.3424           | 2000000          | 6.3010           | 230000           | 5 3617           |
| 7025 | PCGZM S   | 073087 | 1420000          | 6.1523           | 1380000          | 6.1399           | 62000            | 4 7724           |
| 7031 | PCGZM S   | 073087 | 4800000          | 6.6812           | 4800000          | 6.6812           | 59000            | 4 7709           |
| 7057 | PCGZM S   | 073187 | 2250000          | 6.3522           | 2150000          | 6.3324           | 154000           | 5 1931           |



|               |        |          |        |          |        |          |        |
|---------------|--------|----------|--------|----------|--------|----------|--------|
| 7061 PCC4PE   | 073107 | 4500000  | 5.0127 | 4500000  | 5.0127 | 4300000  | 5.4335 |
| 7261 PCC4N5   | 090207 | 600000   | 4.7037 | 600000   | 4.7037 | 420000   | 4.5051 |
| 7764 PCC5F6   | 080207 | 10500000 | 6.0712 | 9400000  | 5.9731 | 126000   | 5.1004 |
| 7030 PCC2F6OC | 073007 | 10300000 | 6.0120 | 8100000  | 5.9035 | 36000    | 4.5563 |
| 7020 PCC2F6OC | 073007 | 40000000 | 6.7702 | 59000000 | 6.7702 | 570000   | 4.7559 |
| 7029 PCC2F6OC | 073007 | 20000000 | 6.3011 | 20000000 | 6.3011 | 47000    | 4.6912 |
|               |        | MEAN     | 6.2277 | MEAN     | 6.2125 | MEAN     | 4.7783 |
|               |        | VARIANCE | 0.5036 | VARIANCE | 0.5040 | VARIANCE | 0.6334 |
| 7763 PPH1N5   | 081007 | 480000   | 5.6812 | 400000   | 5.6812 | 1300000  | 6.1139 |
| 7760 PPH1N5   | 091007 | -10000   | 4.0010 | -10000   | 4.0000 | 174      | 2.1004 |
| 7759 PPH1N5   | 081107 | 550000   | 5.7404 | 540000   | 5.7324 | 500000   | 5.6790 |
| 7762 PPH1N5   | 081107 | 11000000 | 7.0414 | 11000000 | 7.0414 | 2700000  | 6.4314 |
| 7806 PPH1N5   | 081207 | 6200000  | 6.7724 | 6200000  | 6.7724 | 9300000  | 6.9685 |
| 7801 PPH1N5   | 081207 | 20000000 | 7.3010 | 6900000  | 6.9445 | 4200000  | 6.6232 |
| 7827 PPH1N5   | 081307 | 1100000  | 6.0414 | 800000   | 5.9031 | 2400000  | 6.3802 |
| 7830 PPH1N5   | 081307 | 43000000 | 7.6335 | 42000000 | 7.6232 | 1900000  | 6.2708 |
| 7804 PPH1N5OC | 081207 | 9800000  | 6.9712 | 9800000  | 6.9712 | 10100000 | 7.0043 |
| 7805 PPH1N5OC | 081207 | 7200000  | 6.8573 | 7200000  | 6.8573 | 8700000  | 6.9494 |
| 7836 PPH1N5OC | 081307 | 630000   | 5.7973 | 530000   | 5.7243 | 1400000  | 6.1461 |
| 7837 PPH1N5OC | 081307 | 530000   | 5.7243 | 460000   | 5.6628 | 1500000  | 6.1761 |
| 7826 PPH1N5   | 081307 | 90       | 1.9542 | 42       | 1.6232 | 1500     | 3.1761 |
|               |        | MEAN     | 6.2789 | MEAN     | 6.2140 | MEAN     | 5.8244 |
|               |        | VARIANCE | 1.2027 | VARIANCE | 1.1316 | VARIANCE | 2.0799 |
| 7005 SCC1NG   | 072807 | -10      | 1.0000 | -10      | 1.0000 | 1200     | 3.0772 |
| 7006 SCC2NG   | 072807 | -10      | 1.0000 | -10      | 1.0000 | 500      | 2.6990 |
| 7022 SCC2NG   | 072807 | 4000     | 3.6021 | 1100     | 3.0414 | 8500     | 3.9294 |
| 7019 SCC3NG   | 072807 | 21000000 | 7.3222 | 14000000 | 7.1461 | 210000   | 5.3222 |
| 7051 SCC3NG   | 073007 | 1700000  | 6.2304 | 1200000  | 6.0772 | 190000   | 5.2788 |
| 7054 SCC4NG   | 073007 | 9400000  | 6.9823 | 8900000  | 6.9494 | 180000   | 5.2553 |
| 7085 SCC4NG   | 073107 | 28000000 | 7.4472 | 25000000 | 7.3979 | 5000     | 3.6990 |
| 7080 SCC5NGS  | 073107 | 4200000  | 6.6232 | 3300000  | 6.5185 | 300      | 2.4771 |
| 7079 SCC2NGOC | 073107 | 3400000  | 6.5563 | 3200000  | 6.5051 | -100     | 2.0000 |
| 7050 SCC4NGOC | 073007 | 1599999  | 6.2041 | 1599999  | 6.2041 | 100      | 2.0000 |
| 7086 SCC4NGOC | 073107 | 30000000 | 7.4771 | 27000000 | 7.4314 | 3000     | 3.4771 |
| 7056 SCC3NGR  | 073007 | 1800000  | 6.2553 | 1600000  | 6.2041 | 200000   | 5.3010 |
| 7088 SCC4NGR  | 073107 | 30000000 | 7.4771 | 20000000 | 7.4472 | 3000     | 3.4771 |
| 7087 SCC4NGR  | 073107 | 28000000 | 7.4472 | 26000000 | 7.4150 | 5000     | 3.6990 |
|               |        | MEAN     | 5.0259 | MEAN     | 4.8916 | MEAN     | 3.9675 |
|               |        | VARIANCE | 6.6761 | VARIANCE | 6.6711 | VARIANCE | 1.2383 |
| 7097 SNG1NG   | 080107 | 32000000 | 7.5051 | 32000000 | 7.5051 | 21000    | 4.3272 |

|      |          |         |           |        |           |        |          |        |
|------|----------|---------|-----------|--------|-----------|--------|----------|--------|
| 7754 | SIG7FG   | 1802787 | 410000000 | 7.4021 | 751000000 | 7.3979 | -100     | 2.0000 |
| 7757 | SIG2LUS  | 090287  | 310000000 | 7.4914 | 220000000 | 7.3424 | -100     | 2.0000 |
| 7760 | SIG3FG   | 080287  | 410000    | 4.6121 | 100000    | 4.0000 | 8000     | 2.9031 |
| 7761 | SIG3FG   | 080387  | 190000000 | 7.2709 | 8000000   | 6.9031 | 16000    | 4.2041 |
| 7407 | SIG4MG   | 080487  | 102000000 | 8.0066 | 91000000  | 7.9590 | 3000     | 3.4771 |
| 7410 | SIG4MG   | 080487  | 80000000  | 7.9031 | 68000000  | 7.8325 | 14000    | 4.1461 |
| 7413 | SIG3FG   | 080487  | 280000000 | 8.4472 | 90000000  | 7.9542 | 4700000  | 6.4721 |
| 7255 | SIG2FGOC | 090287  | 35000000  | 7.5441 | 11000000  | 7.0414 | 400      | 2.6021 |
| 7256 | SIG2FGOC | 080287  | 25000000  | 7.3979 | 17000000  | 7.2304 | 1100     | 3.0414 |
|      |          |         | MEAN      | 7.3353 | MEAN      | 7.0789 | MEAN     | 3.9607 |
|      |          |         | VARIANCE  | 1.3694 | VARIANCE  | 1.7004 | VARIANCE | 1.8247 |
| 7435 | SUR1MG   | 080587  | 16000000  | 7.2041 | 16000000  | 7.2041 | -10000   | 4.0000 |
| 7438 | SUR1MG   | 080587  | 16000000  | 7.2041 | 16000000  | 7.2041 | -10000   | 4.0000 |
| 7451 | SUR2MG   | 080687  | 114000000 | 8.0569 | 114000000 | 8.0569 | 8600     | 3.9345 |
| 7457 | SUR2MG   | 080687  | 143000000 | 8.1553 | 143000000 | 8.1553 | 3000     | 3.4771 |
| 7519 | SUR3MG   | 080687  | 38000000  | 7.5798 | 28000000  | 7.4472 | -10000   | 4.0000 |
| 7522 | SUR3MG   | 080687  | 144000000 | 8.1564 | 144000000 | 8.1564 | -10000   | 4.0000 |
| 7528 | SUR4MG   | 080687  | 100000000 | 8.0000 | 100000000 | 8.0000 | -10000   | 4.0000 |
| 7525 | SUR4MG   | 080687  | 95000000  | 7.9777 | 95000000  | 7.9777 | -100000  | 5.0000 |
| 7450 | SUR2FGOC | 080687  | 60        | 1.7782 | 10        | 1.0000 | 142      | 2.1523 |
| 7456 | SUR2FGOC | 080687  | 166000000 | 8.1644 | 118000000 | 8.0719 | 10000    | 4.0000 |
|      |          |         | MEAN      | 7.7920 | MEAN      | 7.7755 | MEAN     | 4.0515 |
|      |          |         | VARIANCE  | 0.1438 | VARIANCE  | 0.1528 | VARIANCE | 0.1571 |
| 7001 | SOC1NH   | 072887  | 61000     | 4.7853 | 18000     | 4.2553 | 332      | 2.5211 |
| 7002 | SOC2NH   | 072887  | 18200     | 4.2601 | 2100      | 3.3222 | 70       | 1.8451 |
| 7023 | SOC2NH   | 072987  | 100000    | 5.0000 | 70000     | 4.8451 | 3700     | 3.5682 |
| 7020 | SOC3NH   | 072987  | 3800000   | 6.5798 | 3700000   | 6.5482 | 3100     | 3.4914 |
| 7047 | SOC3NH   | 073087  | 25000     | 4.3979 | 22200     | 4.3444 | 1400     | 3.1441 |
| 7053 | SOC4NH   | 073087  | 19000     | 4.2788 | 14600     | 4.1644 | 30000    | 4.4771 |
| 7083 | SOC4NH   | 073187  | 6500000   | 6.8129 | 6100000   | 6.7853 | 6600     | 3.8195 |
| 7078 | SOC2HOC  | 073187  | 7000000   | 6.8451 | 1800000   | 6.2553 | 19000    | 4.2788 |
| 7049 | SOC4HOC  | 073087  | 1300000   | 6.1139 | 780000    | 5.8721 | 3400     | 3.5543 |
| 7084 | SOC4HOC  | 073187  | 2000000   | 7.3010 | 1900000   | 7.2788 | 6900     | 3.8388 |
| 7055 | SOC4HOC  | 073087  | 13000     | 4.1139 | 9000      | 3.9542 | 31000    | 4.4914 |
|      |          |         | MEAN      | 5.1593 | MEAN      | 4.8981 | MEAN     | 3.2649 |
|      |          |         | VARIANCE  | 1.0116 | VARIANCE  | 1.4419 | VARIANCE | 0.6434 |
| 7096 | SIG1H    | 080187  | 15000000  | 7.1761 | 14000000  | 7.1461 | 34000    | 4.5315 |
| 7252 | SIG2H    | 080287  | 3900000   | 6.5798 | 2500000   | 6.4424 | 900000   | 5.9542 |
| 7253 | SIG2H    | 080287  | 640000    | 5.8062 | 320000    | 5.5051 | 150000   | 5.1761 |
| 7258 | SIG3H    | 080287  | 40000     | 4.6021 | 40000     | 4.6021 | 112000   | 5.0492 |
| 7340 | SIG3H    | 080387  | 13000000  | 7.1139 | 4000000   | 6.6021 | 2500000  | 6.3979 |

|               |          |        |          |        |          |        |          |        |
|---------------|----------|--------|----------|--------|----------|--------|----------|--------|
| 7406 SGC4H    | STC4M H  | 080487 | 3000000  | 6.4771 | 1200000  | 6.0792 | 2250000  | 6.3522 |
| 7409 SGC4H    | STC4M H  | 080487 | 6700000  | 6.8261 | 2000000  | 6.3010 | 4100000  | 6.6128 |
| 7412 SGC5H    | STC5M H  | 080487 | 1000000  | 6.0000 | 800000   | 5.9031 | 142000   | 5.1523 |
| 7251 SGC2H OC | STC2H OC | 080287 | 13000000 | 7.1137 | 9400000  | 6.9731 | 300000   | 5.4771 |
| 7250 SGC2H OC | STC2H OC | 080287 | 3400000  | 6.5563 | 2600000  | 6.4150 | 700000   | 5.8451 |
| 7414 SGC5H R  | STC5H R  | 080487 | 200000   | 5.3010 | 100000   | 5.0000 | 126000   | 5.1072 |
|               | MEAN     |        | VARIANCE | 6.3227 | MEAN     | 6.0751 | MEAN     | 5.6533 |
|               |          |        |          | 0.6286 | VARIANCE | 0.5160 | VARIANCE | 0.5195 |
| 7434 SJR1H    | SJR1M H  | 080587 | 3300000  | 6.5185 | 400000   | 5.6021 | 220000   | 5.3424 |
| 7437 SJR1H    | SJR1M H  | 080587 | 5500000  | 6.7404 | 310000   | 5.4914 | 2600000  | 6.6150 |
| 7449 SJR2H    | SJR2M H  | 080487 | 13100000 | 7.1173 | 9300000  | 6.9685 | 1300000  | 6.1139 |
| 7455 SJR2H    | SJR2M H  | 080487 | 6000000  | 6.7782 | 2100000  | 6.3222 | 1000000  | 6.0000 |
| 7518 SJR3H    | SJR3M H  | 080687 | 4200000  | 7.6232 | 2700000  | 7.4624 | 8600000  | 6.9345 |
| 7521 SJR3H    | SJR3M H  | 080687 | 5300000  | 6.7263 | 5300000  | 6.7263 | 16000000 | 7.2041 |
| 7524 SJR4H    | SJR4M H  | 080887 | 20000000 | 7.3010 | 20000000 | 7.3010 | 5600000  | 6.7482 |
| 7527 SJR4H    | SJR4M H  | 080887 | 2300000  | 6.3617 | 2300000  | 6.3617 | 3500000  | 6.5441 |
| 7448 SJR2H OC | SJR2H OC | 080487 | 3100000  | 6.4914 | 2200000  | 6.3424 | 1230000  | 6.0899 |
| 7454 SJR2H OC | SJR2H OC | 080487 | 9700000  | 6.9848 | 2400000  | 6.3802 | 1300000  | 6.1139 |
| 7439 SJR1H R  | SJR1H R  | 080587 | 5200000  | 6.7160 | 320000   | 5.5051 | 2700000  | 6.4314 |
| 7458 SJR2H R  | SJR2H R  | 080687 | 3000000  | 6.4771 | 3000000  | 6.4771 | 1000000  | 6.0000 |
|               | MEAN     |        | VARIANCE | 6.8956 | MEAN     | 6.5292 | MEAN     | 6.6128 |
|               |          |        |          | 0.1547 | VARIANCE | 0.4631 | VARIANCE | 0.3042 |
| 7003 SGC1S    | SGC1M S  | 072887 | 400000   | 5.6021 | 115000   | 5.0607 | 426      | 2.6294 |
| 7004 SGC2S    | SGC2M S  | 072887 | 9000     | 3.9542 | 2000     | 3.3010 | 100      | 2.0000 |
| 7024 SGC2S    | SGC2M S  | 072987 | 157000   | 5.1959 | 35000    | 4.5441 | 6300     | 3.7993 |
| 7021 SGC3S    | SGC3M S  | 072987 | 340000   | 5.5315 | 200000   | 5.3010 | 240000   | 5.3602 |
| 7046 SGC3S    | SGC3M S  | 073087 | 2800     | 3.4472 | 2200     | 3.3424 | 13000    | 4.1139 |
| 7052 SGC4S    | SGC4M S  | 073087 | 200000   | 5.3010 | 195000   | 5.2900 | 7300     | 3.8633 |
| 7081 SGC4S    | SGC4M S  | 073187 | 770000   | 5.8865 | 590000   | 5.7709 | 56000    | 4.7482 |
| 7076 SGC2H OC | SGC2H OC | 073187 | 10000000 | 7.0000 | 9900000  | 6.9956 | 10600    | 4.0253 |
| 7075 SGC2H OC | SGC2H OC | 073187 | 1600000  | 6.2061 | 1100000  | 6.0614 | 17000    | 4.2304 |
| 7077 SGC2H OC | SGC2H OC | 073187 | 650000   | 5.8129 | 640000   | 5.8062 | 6500     | 3.8129 |
| 7048 SGC4H OC | SGC4H OC | 073087 | 30000000 | 7.4771 | 23000000 | 7.3617 | -10      | 1.0000 |
| 7082 SGC4H OC | SGC4H OC | 073187 | 810000   | 5.9085 | 590000   | 5.7634 | 43000    | 4.6335 |
|               | MEAN     |        | VARIANCE | 6.9853 | MEAN     | 6.6586 | MEAN     | 3.7904 |
|               |          |        |          | 0.7234 | VARIANCE | 0.8284 | VARIANCE | 1.1583 |
| 7246 SGC2H S  | STC2M S  | 080287 | 540000   | 5.7324 | 430000   | 5.6335 | 13400    | 4.1335 |
| 7075 SGC1S    | STC1M S  | 080187 | 950000   | 5.9777 | 900000   | 5.9542 | 23000    | 4.3617 |
| 7249 SGC2S    | STC2M S  | 080287 | 510000   | 5.7076 | 410000   | 5.6128 | 19300    | 4.2856 |
| 7259 SGC3S    | STC3M S  | 080287 | 560000   | 5.7482 | 200000   | 5.3010 | 9200     | 3.9638 |
| 7359 SGC3S    | STC3M S  | 080387 | 1500000  | 6.1761 | 1100000  | 6.0414 | 14800    | 4.1703 |



## TAXONOMY DATA





Ryan Analytical Services  
MOE - Grey Water Project 1987  
Beak Consultants Ltd.  
Bacterial Isolates Identification

| Tube/ Date | Plate Isolated | Target  | E-II Code      | Organism |
|------------|----------------|---------|----------------|----------|
| No. mnddy  | Organism       | /Media  | Identified     |          |
| 21 080387  | +PA            | 00001   | P cepacia      |          |
| 22 080387  | -PA            | 00003   | A lwoffii      |          |
| 23 080387  | +PA            | 21043   | C freundii     |          |
| 24 080387  | -PA            | 00043   | A anitratus    |          |
| 25 080387  | +PA            | 00141   | A anitratus    |          |
| 1 080487   | +FC            | 34361   | K pneumoniae   |          |
| 2 080487   | +FC            | 34363   | K pneumoniae   |          |
| 3 080487   | +FC            | 32163   | E cloacae      |          |
| 4 080487   | +FC            | 34363   | K pneumoniae   |          |
| 5 080487   | +FC            | 24373   | K pneumoniae   |          |
| 6 080487   | +FC            | 32560   | E coli         |          |
| 7 080487   | +FC            | 34373   | K pneumoniae   |          |
| 8 080487   | -FC            | 00141   | A anitratus    |          |
| 9 080487   | -FC            | 00141   | A anitratus    |          |
| 10 080487  | -FC            | 00141   | A anitratus    |          |
| 11 080487  | +FC            | 22163   | E cloacae      |          |
| 12 080487  | -FC            | 00141   | A anitratus    |          |
| 13 080487  | +FC            | 20165   | E agglomerans  |          |
| 14 080487  | +FC            | 34763   | K oxytoca      |          |
| 15 080487  | +FC            | 32173   | E cloacae      |          |
| 16 080487  | +FC            | 32173   | E cloacae      |          |
| 17 080487  | +FC            | 34563   | K oxytoca      |          |
| 18 080487  | +FC            | 22163   | E cloacae      |          |
| 19 080487  | -FC            | 00143   | A anitratus    |          |
| 20 080487  | -FC            | 32063   | E cloacae      |          |
| 32 080787  | +FC            | 34172   | K pneumoniae   |          |
| 33 080787  | +FC            | 34361   | K pneumoniae   |          |
| 34 080787  | +FC            | 34163   | K pneumoniae   |          |
| 35 080787  | +FC            | 32361   | E cloacae      |          |
| 51 080787  | +FC            | 22161   | E cloacae      |          |
| 36 080887  | +EC            | 30165   | E agglomerans  |          |
| 37 080887  | +EC            | 32361   | E cloacae      |          |
| 38 080887  | +EC            | 32161   | E cloacae      |          |
| 39 080887  | +EC            | 32165   | S liquefaciens |          |
| 40 080887  | +EC            | 32161   | E cloacae      |          |
| 41 080987  | +EC            | 22161   | E cloacae      |          |
| 42 080987  | +EC            | 20173   | C freundii     |          |
| 43 080987  | +EC            | 22163   | E cloacae      |          |
| 44 080987  | +EC            | 20163   | C freundii     |          |
| 45 080987  | +EC            | 22171   | E cloacae      |          |
| 1 081087   | +PA            | Milk ag | P aeruginosa   |          |
| 2 081087   | +PA            | Milk ag | P aeruginosa?  |          |
| 3 081087   | +PA            | Milk ag | P aeruginosa   |          |
| 4 081087   | +PA            | Milk ag | P aeruginosa   |          |
| 5 081087   | +PA            | Milk ag | P aeruginosa   |          |

Ryan Analytical Services  
MOE - Grey Water Project 1987  
Beak Consultants Ltd.  
Bacterial Isolates Identification

| Tube/ Date<br>Plate Isolated<br>No. mmdyy | Target<br>Organism | E-II Code<br>/Media | Organism<br>Identified |
|---|--------------------|---------------------|------------------------|
| 6 081087                                  | +PA                | Milk ag             | P aeruginosa           |
| 7 081087                                  | +PA                | Milk ag             | P aeruginosa           |
| 8 081087                                  | +PA                | Milk ag             | P aeruginosa           |
| 9 081087                                  | +PA                | Milk ag             | P aeruginosa           |
| 10 081087                                 | +PA                | Milk ag             | P aeruginosa           |
| 11 081087                                 | +PA                | Milk ag             | P aeruginosa           |
| 12 081087                                 | +PA                | Milk ag             | P aeruginosa           |
| 13 081087                                 | +PA                | Milk ag             | P aeruginosa?          |
| 14 081087                                 | +PA                | Milk ag             | P aeruginosa?          |
| 15 081087                                 | +PA                | Milk ag             | P aeruginosa           |
| 16 081087                                 | +PA                | Milk ag             | P aeruginosa           |
| 46 081087                                 | +EC                | 30560               | E coli                 |
| 47 081087                                 | +EC                | 36173               | K pneumoniae           |
| 48 081087                                 | +EC                | 22161               | E cloacae              |
| 49 081087                                 | +EC                | 31360               | C freundli             |
| 50 081087                                 | +EC                | 32171               | E cloacae              |
| 17 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 18 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 19 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 20 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 21 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 22 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 23 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 24 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 25 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 26 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 27 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 28 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 29 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 30 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 31 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 32 081187                                 | +PA                | Milk ag             | P aeruginosa           |
| 51 081187                                 | +EC                | 32163               | E cloacae              |
| 52 081187                                 | +EC                | 00041               | A anitratus            |
| 53 081187                                 | +EC                | 36560               | E coli                 |
| 54 081187                                 | +EC                | 31161               | C freundli             |
| 55 081187                                 | +EC                | 32371               | E cloacae              |
| 56 081287                                 | +EC                | 200143              | E agglomerans          |
| 57 081287                                 | +EC                | 321633              | E cloacae              |
| 58 081287                                 | +EC                | 36363               | K pneumoniae           |
| 59 081287                                 | +EC                | 32163               | E cloacae              |
| 60 081287                                 | +EC                | 32541               | E sakazakii            |
| 61 081287                                 | +EC                | 34777               | K oxytoca              |
| 62 081287                                 | +EC                | 32157               | E cloacae              |
| 63 081287                                 | +EC                | 32177               | ?????                  |

Ryan Analytical Services  
MOE - Grey Water Project 1987  
Beak Consultants Ltd.  
Bacterial Isolates Identification

| Tube/<br>Plate | Date<br>Isolated | Target<br>Organism | E-II Code<br>/Media | Organism<br>Identified |
|----------------|------------------|--------------------|---------------------|------------------------|
| 64             | 081287           | +EC                | 30173               | C freundli             |
| 65             | 081287           | +EC                | 32173               | C freundli             |
| 66             | 081287           | +EC                | 32163               | E cloacae              |
| 67             | 081287           | +EC                | 32161               | E cloacae              |
| 68             | 081287           | +EC                | 30561               | C amaloniticus         |
| 69             | 081287           | +EC                | 30561               | C amaloniticus         |
| 70             | 081287           | +EC                | 32163               | E cloacae              |
| 71             | 081287           | +EC                | 24363               | K pneumoniae           |
| 72             | 081287           | +EC                | 32363               | E cloacae              |
| 73             | 081287           | +EC                | 32160               | C freundli             |
| 74             | 081287           | +EC                | 32163               | E cloacae              |
| 75             | 081287           | +EC                | 32163               | E cloacae              |
| 76             | 081287           | +EC                | 32163               | E cloacae              |
| 77             | 081287           | +EC                | 32143               | E cloacae              |
| 78             | 081287           | +EC                | 32573               | C amaloniticus         |
| 79             | 081287           | +EC                | 32540               | E coli                 |
| 80             | 081287           | +EC                | 32163               | E cloacae              |
| 84             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 85             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 86             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 87             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 88             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 89             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 90             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 91             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 92             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 93             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 94             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 95             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 96             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 97             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 98             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 99             | 081287           | +PA                | Milk ag             | P aeruginosa           |
| 81             | 081387           | +EC                | 32163               | E cloacae              |
| 82             | 081387           | +EC                | 31163               | C freundli             |
| 83             | 081387           | +EC                | 32163               | E cloacae              |
| 84             | 081387           | +EC                | 30560               | E coli                 |
| 85             | 081387           | +EC                | 32163               | E cloacae              |



## **APPENDIX B**

### **PUMPOUT SURVEY RESULTS**





### SEARCH OF REGIONAL PAVILIONS

| SUBMIT CODE | BUSINESS NAME                          | BUSINESS ADDRESS  | MARINA | MOVING |       | TIMES |       | HOURS |       | HOLDING | TITLE | NO. 101A |       | +ALL | NUTR3 | 3W1 |      |       |
|-------------|--|---|--------|--------|-------|-------|-------|-------|-------|---------|-------|----------|-------|------|-------|-----|------|-------|
|             |  |   |        | OPEN   | CLOSE | OPEN  | CLOSE | OPEN  | CLOSE |         |       | OPEN     | CLOSE |      |       |     | OPEN | CLOSE |
| UPT-35      | SCOTT'S RIBBLE MARINE                  | BOX 519 LAKESHIELD, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | F       | F     | 1        | 1350  | 2    | 10    | 13  | 30   |       |
| UPT-36      | DEEP BAY MARINE (STONY LAKE)           | R.R.1 LAKESHIELD, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | F     | 1        | 1     | 1    | 5     | 13  | 18   |       |
| UPT-37      | DEEP BAY MARINE (BALSHEON FALLS)       | R.R.4 LAKESHIELD, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 180      | 1     | 10   | 10    | 24  |      |       |
| UPT-38      | BLOOMER MOOR HARBOR                    | R.R.1 LAKESHIELD, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 1        | 1     | 1    | 10    | 10  | 24   |       |
| UPT-39      | MORNINGSTAR MARINE AND LODGE           | R.R.1 LAKESHIELD, ONTARIO   | 1      | 5      | 9     | 1     | 11    | 1     | 1     | 1       | F     | 1        | 8100  | 2    | 4     | 17  | 13   | 12    |
| BOB-30      | BLIND POINT MARINE LTD.                | R.R.2 REBECCA, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 1175     | 1     | 5    | 16    | 19  | 12   |       |
| BOB-31      | CENTRE POINT LANDING AND MARINA        | BOX 579 REBECCA, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 2200     | 6     | 30   | 10    | 3   | 2    |       |
| BOB-32      | COZYDON YACHT HARBOR                   | BOX 907 REBECCA, ONT.   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 340      | 5     | 40   | 21    | 9   | 24   |       |
| BOB-33      | HOLIDAY MARINA                         | BOX 400 REBECCA, ONTARIO  | 1      | 4      | 11    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 4     | 10   | 50    | 30  | 5    | 24    |
| OLN-34      | DAVE'S MARINE SALES (STURGEON LAKES)   | R.R.2 KENNEDY BAY, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 270      | 3     | 30   | 16    | 18  | 18   |       |
| OLN-35      | V.E. POLAKEN MARINE (LAURISTONIA P.L.) | R.R.2 CLARKE, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 900      | 1     | 40   |       |     |      |       |
| UIM-36      | SUNSHINE MARINE LTD.                   | R.R.6 LINCOLN, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 1        | 1     | 1    | 10    | 12  | 14   | 14    |
| OPN-37      | MARINA LODGE (BALSHEON LAKE)           | R.R.1 CARRINGTON, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 1350     | 2     | 3    | 15    | 10  | 18   |       |
| FN-38       | STANLEY'S MARINA (REEDDALE)            | R.R.1 FREDON FALLS, ONTARIO   | 1      | 4      | 11    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 2     | 5    | 50    | 21  | 18   |       |
| FN-39       | FLEMING'S MARINA (WREDDALE)            | R.R.1 FREDON FALLS, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 6     | 3    | 15    | 10  | 18   |       |
| FN-370      | ELMS MARINA                            | BOX 98 FREDON FALLS, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 1        | 1     | 1    | 1     |     |      |       |
| OLN-41      | BIG OUSE MARINA                        | R.R.1 COLLEMAN, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 5625     | 1     | 3    | 15    | 21  | 3    | 4     |
| PSJ-43      | SEVEN COLE MARINA (SEVEN FALLS)        | R.R.1 COLLEMAN, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 1        | 1     | 1    | 1     | 10  | 13   | 30    |
| MMH-47      | WHITE'S FALLS MARINE CONSTRUCTION      | BOX 97 FOOT SCURRY, ONTARIO   | 1      | 4      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 2430     | 2     | 6    | 40    | 16  | 44   | 44    |
| MMH-47      | ADRIAN'S MARINA INC.                   | BOX 39 HONEY HARBOR, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 4500     | 1     | 12   | 40    | 14  | 24   | 24    |
| MMH-47      | VILLAGE MARINA LTD.                    | 1 GEN. DELIVERY, HONEY HARBOR, ONT  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 4        | 75    | 24   | 24    | 24  | 24   |       |
| MMH-47      | QUEEN'S COLE MARINA                    | BOX 333 VICTORIA HARBOR, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 900      | 2     | 8    | 12    | 12  | 18   | 18    |
| MMH-47      | QUEEN'S MARINA                         | BOX 61 FOOT SCURRY, ONTARIO   | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 4500     | 2     | 10   | 10    | 13  | 9    | 1     |
| PTG-47      | PEWING, TULL (DUM.) DOGS               | QUARTON PEWING, ONTARIO   | 1      | 5      | 11    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 4     | 15   | 100   | 28  | 27   | 27    |
| PTG-47      | QUINCY'S COLE MARINA                   | BOX 1390 PEWING, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 4     | 15   | 100   | 10  | 3    | 15    |
| PTG-40      | BAI MARINE                             | BOX 39 PEWING, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 4     | 15   | 100   | 28  | 24   | 24    |
| PTG-41      | BEACON BAY MARINA                      | BOX 1570 PEWING, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 4     | 15   | 100   | 28  | 24   | 24    |
| PTG-42      | HUNSON MARINE                          | BOX 325 PEWING, ONTARIO   | 1      | 5      | 11    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 2     | 15   | 200   | 10  | 3    | 21    |
| PTG-43      | BAY MARINE                             | BOX 559 PEWING, ONTARIO   | 1      | 5      | 11    | 1     | 11    | 1     | 1     | 1       | 1     | 1        | 1     | 1    | 1     | 1   | 1    | 1     |
| PTG-44      | NORTHWEST BASIN MARINE                 | BOX 1004 PEWING, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 1     | 2    | 15    | 15  | 2    | 15    |
| PTG-45      | MILLIKEN LUG (CITY)                    | S.S. 512 E. 21 CORY, ONTARIO  | 1      | 5      | 10    | 1     | 11    | 1     | 1     | 1       | 1     | 9000     | 1     | 2    | 15    | 15  | 2    | 15    |
| OLN-46      | COLE MARINA                            | 17000 |        |        |       |       |       |       |       |         |       |          |       |      |       |     |      |       |

| 30431    | 30432    | 30433    | 30434    | 30435    | 30436    | 30437    | 30438    | 30439    | 30440    | 30441    | 30442    | 30443    | 30444    | 30445    | 30446    | 30447    | 30448    | 30449    | 30450    |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CODE     | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  | ADDRESS  |
| 00K-101  | 00K-102  | 00K-103  | 00K-104  | 00K-105  | 00K-106  | 00K-107  | 00K-108  | 00K-109  | 00K-110  | 00K-111  | 00K-112  | 00K-113  | 00K-114  | 00K-115  | 00K-116  | 00K-117  | 00K-118  | 00K-119  | 00K-120  |
| 00K-121  | 00K-122  | 00K-123  | 00K-124  | 00K-125  | 00K-126  | 00K-127  | 00K-128  | 00K-129  | 00K-130  | 00K-131  | 00K-132  | 00K-133  | 00K-134  | 00K-135  | 00K-136  | 00K-137  | 00K-138  | 00K-139  | 00K-140  |
| 00K-141  | 00K-142  | 00K-143  | 00K-144  | 00K-145  | 00K-146  | 00K-147  | 00K-148  | 00K-149  | 00K-150  | 00K-151  | 00K-152  | 00K-153  | 00K-154  | 00K-155  | 00K-156  | 00K-157  | 00K-158  | 00K-159  | 00K-160  |
| 00K-161  | 00K-162  | 00K-163  | 00K-164  | 00K-165  | 00K-166  | 00K-167  | 00K-168  | 00K-169  | 00K-170  | 00K-171  | 00K-172  | 00K-173  | 00K-174  | 00K-175  | 00K-176  | 00K-177  | 00K-178  | 00K-179  | 00K-180  |
| 00K-181  | 00K-182  | 00K-183  | 00K-184  | 00K-185  | 00K-186  | 00K-187  | 00K-188  | 00K-189  | 00K-190  | 00K-191  | 00K-192  | 00K-193  | 00K-194  | 00K-195  | 00K-196  | 00K-197  | 00K-198  | 00K-199  | 00K-200  |
| 00K-201  | 00K-202  | 00K-203  | 00K-204  | 00K-205  | 00K-206  | 00K-207  | 00K-208  | 00K-209  | 00K-210  | 00K-211  | 00K-212  | 00K-213  | 00K-214  | 00K-215  | 00K-216  | 00K-217  | 00K-218  | 00K-219  | 00K-220  |
| 00K-221  | 00K-222  | 00K-223  | 00K-224  | 00K-225  | 00K-226  | 00K-227  | 00K-228  | 00K-229  | 00K-230  | 00K-231  | 00K-232  | 00K-233  | 00K-234  | 00K-235  | 00K-236  | 00K-237  | 00K-238  | 00K-239  | 00K-240  |
| 00K-241  | 00K-242  | 00K-243  | 00K-244  | 00K-245  | 00K-246  | 00K-247  | 00K-248  | 00K-249  | 00K-250  | 00K-251  | 00K-252  | 00K-253  | 00K-254  | 00K-255  | 00K-256  | 00K-257  | 00K-258  | 00K-259  | 00K-260  |
| 00K-261  | 00K-262  | 00K-263  | 00K-264  | 00K-265  | 00K-266  | 00K-267  | 00K-268  | 00K-269  | 00K-270  | 00K-271  | 00K-272  | 00K-273  | 00K-274  | 00K-275  | 00K-276  | 00K-277  | 00K-278  | 00K-279  | 00K-280  |
| 00K-281  | 00K-282  | 00K-283  | 00K-284  | 00K-285  | 00K-286  | 00K-287  | 00K-288  | 00K-289  | 00K-290  | 00K-291  | 00K-292  | 00K-293  | 00K-294  | 00K-295  | 00K-296  | 00K-297  | 00K-298  | 00K-299  | 00K-300  |
| 00K-301  | 00K-302  | 00K-303  | 00K-304  | 00K-305  | 00K-306  | 00K-307  | 00K-308  | 00K-309  | 00K-310  | 00K-311  | 00K-312  | 00K-313  | 00K-314  | 00K-315  | 00K-316  | 00K-317  | 00K-318  | 00K-319  | 00K-320  |
| 00K-321  | 00K-322  | 00K-323  | 00K-324  | 00K-325  | 00K-326  | 00K-327  | 00K-328  | 00K-329  | 00K-330  | 00K-331  | 00K-332  | 00K-333  | 00K-334  | 00K-335  | 00K-336  | 00K-337  | 00K-338  | 00K-339  | 00K-340  |
| 00K-341  | 00K-342  | 00K-343  | 00K-344  | 00K-345  | 00K-346  | 00K-347  | 00K-348  | 00K-349  | 00K-350  | 00K-351  | 00K-352  | 00K-353  | 00K-354  | 00K-355  | 00K-356  | 00K-357  | 00K-358  | 00K-359  | 00K-360  |
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| 00K-401  | 00K-402  | 00K-403  | 00K-404  | 00K-405  | 00K-406  | 00K-407  | 00K-408  | 00K-409  | 00K-410  | 00K-411  | 00K-412  | 00K-413  | 00K-414  | 00K-415  | 00K-416  | 00K-417  | 00K-418  | 00K-419  | 00K-420  |
| 00K-421  | 00K-422  | 00K-423  | 00K-424  | 00K-425  | 00K-426  | 00K-427  | 00K-428  | 00K-429  | 00K-430  | 00K-431  | 00K-432  | 00K-433  | 00K-434  | 00K-435  | 00K-436  | 00K-437  | 00K-438  | 00K-439  | 00K-440  |
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| 00K-461  | 00K-462  | 00K-463  | 00K-464  | 00K-465  | 00K-466  | 00K-467  | 00K-468  | 00K-469  | 00K-470  | 00K-471  | 00K-472  | 00K-473  | 00K-474  | 00K-475  | 00K-476  | 00K-477  | 00K-478  | 00K-479  | 00K-480  |
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| 00K-541  | 00K-542  | 00K-543  | 00K-544  | 00K-545  | 00K-546  | 00K-547  | 00K-548  | 00K-549  | 00K-550  | 00K-551  | 00K-552  | 00K-553  | 00K-554  | 00K-555  | 00K-556  | 00K-557  | 00K-558  | 00K-559  | 00K-560  |
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| 00K-581  | 00K-582  | 00K-583  | 00K-584  | 00K-585  | 00K-586  | 00K-587  | 00K-588  | 00K-589  | 00K-590  | 00K-591  | 00K-592  | 00K-593  | 00K-594  | 00K-595  | 00K-596  | 00K-597  | 00K-598  | 00K-599  | 00K-600  |
| 00K-601  | 00K-602  | 00K-603  | 00K-604  | 00K-605  | 00K-606  | 00K-607  | 00K-608  | 00K-609  | 00K-610  | 00K-611  | 00K-612  | 00K-613  | 00K-614  | 00K-615  | 00K-616  | 00K-617  | 00K-618  | 00K-619  | 00K-620  |
| 00K-621  | 00K-622  | 00K-623  | 00K-624  | 00K-625  | 00K-626  | 00K-627  | 00K-628  | 00K-629  | 00K-630  | 00K-631  | 00K-632  | 00K-633  | 00K-634  | 00K-635  | 00K-636  | 00K-637  | 00K-638  | 00K-639  | 00K-640  |
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| 00K-681  | 00K-682  | 00K-683  | 00K-684  | 00K-685  | 00K-686  | 00K-687  | 00K-688  | 00K-689  | 00K-690  | 00K-691  | 00K-692  | 00K-693  | 00K-694  | 00K-695  | 00K-696  | 00K-697  | 00K-698  | 00K-699  | 00K-700  |
| 00K-701  | 00K-702  | 00K-703  | 00K-704  | 00K-705  | 00K-706  | 00K-707  | 00K-708  | 00K-709  | 00K-710  | 00K-711  | 00K-712  | 00K-713  | 00K-714  | 00K-715  | 00K-716  | 00K-717  | 00K-718  | 00K-719  | 00K-720  |
| 00K-721  | 00K-722  | 00K-723  | 00K-724  | 00K-725  | 00K-726  | 00K-727  | 00K-728  | 00K-729  | 00K-730  | 00K-731  | 00K-732  | 00K-733  | 00K-734  | 00K-735  | 00K-736  | 00K-737  | 00K-738  | 00K-739  | 00K-740  |
| 00K-741  | 00K-742  | 00K-743  | 00K-744  | 00K-745  | 00K-746  | 00K-747  | 00K-748  | 00K-749  | 00K-750  | 00K-751  | 00K-752  | 00K-753  | 00K-754  | 00K-755  | 00K-756  | 00K-757  | 00K-758  | 00K-759  | 00K-760  |
| 00K-761  | 00K-762  | 00K-763  | 00K-764  | 00K-765  | 00K-766  | 00K-767  | 00K-768  | 00K-769  | 00K-770  | 00K-771  | 00K-772  | 00K-773  | 00K-774  | 00K-775  | 00K-776  | 00K-777  | 00K-778  | 00K-779  | 00K-780  |
| 00K-781  | 00K-782  | 00K-783  | 00K-784  | 00K-785  | 00K-786  | 00K-787  | 00K-788  | 00K-789  | 00K-790  | 00K-791  | 00K-792  | 00K-793  | 00K-794  | 00K-795  | 00K-796  | 00K-797  | 00K-798  | 00K-799  | 00K-800  |
| 00K-801  | 00K-802  | 00K-803  | 00K-804  | 00K-805  | 00K-806  | 00K-807  | 00K-808  | 00K-809  | 00K-810  | 00K-811  | 00K-812  | 00K-813  | 00K-814  | 00K-815  | 00K-816  | 00K-817  | 00K-818  | 00K-819  | 00K-820  |
| 00K-821  | 00K-822  | 00K-823  | 00K-824  | 00K-825  | 00K-826  | 00K-827  | 00K-828  | 00K-829  | 00K-830  | 00K-831  | 00K-832  | 00K-833  | 00K-834  | 00K-835  | 00K-836  | 00K-837  | 00K-838  | 00K-839  | 00K-840  |
| 00K-841  | 00K-842  | 00K-843  | 00K-844  | 00K-845  | 00K-846  | 00K-847  | 00K-848  | 00K-849  | 00K-850  | 00K-851  | 00K-852  | 00K-853  | 00K-854  | 00K-855  | 00K-856  | 00K-857  | 00K-858  | 00K-859  | 00K-860  |
| 00K-861  | 00K-862  | 00K-863  | 00K-864  | 00K-865  | 00K-866  | 00K-867  | 00K-868  | 00K-869  | 00K-870  | 00K-871  | 00K-872  | 00K-873  | 00K-874  | 00K-875  | 00K-876  | 00K-877  | 00K-878  | 00K-879  | 00K-880  |
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| 00K-901  | 00K-902  | 00K-903  | 00K-904  | 00K-905  | 00K-906  | 00K-907  | 00K-908  | 00K-909  | 00K-910  | 00K-911  | 00K-912  | 00K-913  | 00K-914  | 00K-915  | 00K-916  | 00K-917  | 00K-918  | 00K-919  | 00K-920  |
| 00K-921  | 00K-922  | 00K-923  | 00K-924  | 00K-925  | 00K-926  | 00K-927  | 00K-928  | 00K-929  | 00K-930  | 00K-931  | 00K-932  | 00K-933  | 00K-934  | 00K-935  | 00K-936  | 00K-937  | 00K-938  | 00K-939  | 00K-940  |
| 00K-941  | 00K-942  | 00K-943  | 00K-944  | 00K-945  | 00K-946  | 00K-947  | 00K-948  | 00K-949  | 00K-950  | 00K-951  | 00K-952  | 00K-953  | 00K-954  | 00K-955  | 00K-956  | 00K-957  | 00K-958  | 00K-959  | 00K-960  |
| 00K-961  | 00K-962  | 00K-963  | 00K-964  | 00K-965  | 00K-966  | 00K-967  | 00K-968  | 00K-969  | 00K-970  | 00K-971  | 00K-972  | 00K-973  | 00K-974  | 00K-975  | 00K-976  | 00K-977  | 00K-978  | 00K-979  | 00K-980  |
| 00K-981  | 00K-982  | 00K-983  | 00K-984  | 00K-985  | 00K-986  | 00K-987  | 00K-988  | 00K-989  | 00K-990  | 00K-991  | 00K-992  | 00K-993  | 00K-994  | 00K-995  | 00K-996  | 00K-997  | 00K-998  | 00K-999  | 00K-1000 |
| 00K-1001 | 00K-1002 | 00K-1003 | 00K-1004 | 00K-1005 | 00K-1006 | 00K-1007 | 00K-1008 | 00K-1009 | 00K-1010 | 00K-1011 | 00K-1012 | 00K-1013 | 00K-1014 | 00K-1015 | 00K-1016 | 00K-1017 | 00K-1018 | 00K-1019 | 00K-1020 |
| 00K-1021 | 00K-1022 | 00K-1023 | 00K-1024 | 00K-1025 | 00K-1026 | 00K-1027 | 00K-1028 | 00K-1029 | 00K-1030 | 00K-1031 | 00K-1032 | 00K-1033 | 00K-1034 | 00K-1035 | 00K-1036 | 00K-1037 | 00K-1038 | 00K-1039 | 00K-1040 |
| 00K-1041 | 00K-1042 | 00K-1043 | 00K-1044 | 00K-1045 | 00K-1046 | 00K-1047 | 00K-1048 | 00K-1049 | 00K-1050 | 00K-1051 | 00K-1052 | 00K-1053 | 00K-1054 | 00K-1055 | 00K-1056 | 00K-1057 | 00K-1058 | 00K-1059 | 00K-1060 |
| 00K-1061 | 00K-1062 | 00K-1063 | 00K-1064 | 00K-1065 | 00K-1066 | 00K-1067 | 00K-1068 | 00K-1069 | 00K-1070 | 00K-1071 | 00K-1072 | 00K-1073 | 00K-1074 | 00K-1075 | 00K-1076 | 00K-1077 | 00K-1078 | 00K-1079 | 00K-1080 |
| 00K-1081 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |



